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Integrated Humanization as a Gulf Mobility Strategy: Blue–Green Corridors in Muscat

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ABSTRACT

Gulf cities are under growing pressure from car dependency, rapid urbanization, and extreme climatic stress. Conventional models of "humanizing cities," imported from Western or East Asian contexts, emphasize walkability and livability but fail to adapt to the hot-arid conditions of the Arabian Peninsula, where long walking trips remain impractical. This paper advances Integrated Humanization (IH) as a Gulf mobility strategy framework that merges urban planning, urban humanization, public transport, road engineering, and micro-mobility into a single human-centered system. The contribution of this study lies in expanding IH through the novel concept of Blue-Green Corridors, which reimagine wadis (flood channels) not merely as drainage infrastructure but as multifunctional urban assets. By transforming wadis into urban lakes with shaded pedestrian and cycling paths, micro-mobility networks, and water-based transport hubs, these corridors integrate seamlessly with metro and BRT systems. The approach reframes water infrastructure as both ecological and mobility infrastructure. The research applies policy analysis of Oman Vision 2040 and the Greater Muscat Structure Plan, comparative insights from international cases, and a pilot project proposal for Muscat. The results indicate that Blue-Green Corridors can reduce congestion, enhance thermal comfort, reclaim stormwater for beneficial use, and create high-quality public spaces—at significantly lower costs than large-scale highway expansion. Findings indicate that IH—operationalized through Blue-Green Corridors—is not a luxury but a necessity. Compared with costly highway expansion, this approach reduces congestion, enhances equity, mitigates heat, and provides Gulf cities with a culturally adapted, climate-responsive urban strategy. Ultimately, Muscat's pilot can serve as a regional benchmark for rethinking Gulf urbanism.

INTRODUCTION

Across the Gulf region, cities are facing a decisive turning point. Built on rapid development and automobile-based mobility, urban systems are increasingly strained by congestion, environmental degradation, and social alienation. The contemporary Gulf city is not merely a network of streets and districts but a complex organism where human life, economic growth, and cultural identity converge. However, the dominance of cars and infrastructure designed almost exclusively for motorized mobility has led to what Al-Kindi (2021) terms an "urban imbalance."

In the Sultanate of Oman, this imbalance manifests vividly in the treatment of wadis (valleys) and their associated flood corridors. These wadis, which cover significant portions of Muscat and other Gulf cities, are legally designated under Royal Decrees as natural conduits for stormwater and flash-flood management. While their hydrological importance is undisputed, their current urban role is limited to drainage infrastructure—often fenced, barren, and divorced from the surrounding communities. This narrow functional framing renders them underutilized urban assets, despite their spatial scale and centrality in city layouts (MoHUP, 2021).

Rethinking Gulf Urbanism through Blue-Green Corridors and Integrated Humanization

This paper argues that leaving wadis solely as drainage channels is no longer tenable in a 21st-century urban context. Instead, they can be transformed into blue-green corridors that integrate water storage, ecological services, mobility functions, and urban humanization. Through the creation of artificial lakes within wadi beds, supported by retention and recharged dams, these corridors could simultaneously:

- increase the green footprint of cities,
- lower urban heat through evaporative cooling,
- provide shaded promenades and micro-mobility corridors,
- create opportunities for waterborne transport,
- and conserve stormwater currently lost to the sea.

When reframed through the lens of Integrated Humanization (IH)—a Gulf-centric paradigm developed by Eng. Mohammad Abdullah Saad, wadis are no longer peripheral or "forbidden" spaces but central urban assets. As shown in Figure 1, Integrated Humanization proposes a fusion of five interdependent domains: urban planning, urban humanization, public transport, road engineering, and micro-mobility. In this expanded paradigm, wadis and their artificial lakes become the connective tissue where these domains converge. The wadi-lake system acts

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as the physical and conceptual spine where the five IH dimensions intersect:

- Urban Planning: reclassifying wadi corridors as multi-functional spaces within metropolitan masterplans.
- Urban Humanization: designing lakeside promenades, shaded walkways, and inclusive public realms.
- Public Transport: integrating ferry or water-taxi stations at lakes with BRT and metro stops.
- Road Engineering: redistributing flows by shifting part of the mobility demand to water-based systems.
- Micro-Mobility: enabling e-scooters, e-bikes, and shared buggies to provide seamless access to waterfront hubs.

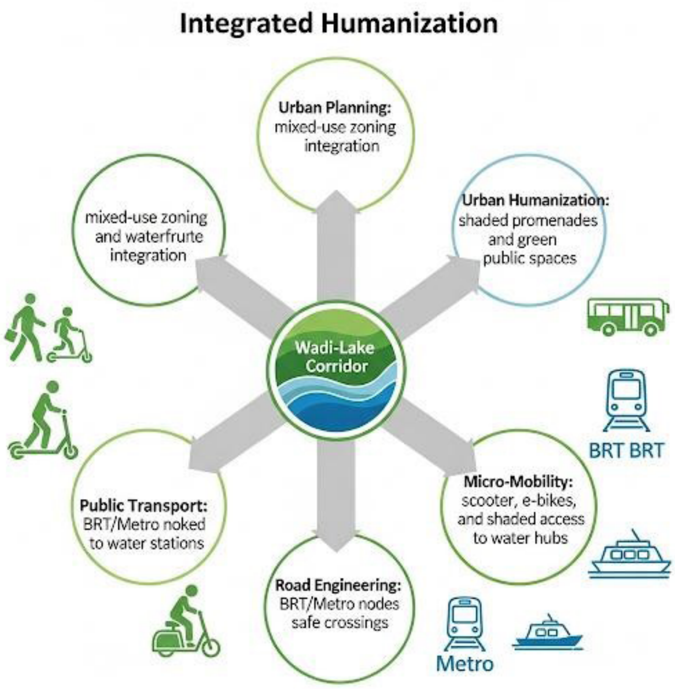

Figure 1: illustrates how the wadi-lake corridor acts as the central spine where the five dimensions of Integrated Humanization converge—demonstrating their mutual reinforcement in a Gulf-specific context.

Extending the Humanization Paradigm to Gulf Realities

This integration extends the earlier notion of humanizing cities—originally developed in Euro-American contexts (Gehl, 2010; Newman & Kenworthy, 2015)—into a comprehensive mobility and livability strategy suited to Gulf realities. Unlike imported frameworks, which often assume temperate climates and compact densities, Integrated Humanization recognizes the dual challenge of Gulf cities: extreme climate and entrenched car dependency. By embedding blue-green corridors into the paradigm, the model evolves into a climate-responsive mobility ecosystem that combines pedestrians, micro-mobility, BRT, metro, and water transport.

Within Oman, both Oman Vision 2040 and the Greater Muscat Structure Plan (GMSP) provide the policy scaffolding for such a reimagining. Vision 2040 explicitly calls for sustainable cities that balance human well-being, environmental resilience, and economic diversification (Oman Vision 2040, 2020). The GMSP, in turn, outlines ambitious metro and BRT corridors but acknowledges bottlenecks in first/last-mile access (MoHUP, 2021; Heyman & Hasan, 2023).

Without integrated neighborhood-scale and corridor-based solutions, these high-cost transit systems risk underutilization. Transforming wadis into blue-green corridors thus represents more than beautification; it is a structural intervention that addresses water management, mobility diversification, and urban livability in one stroke. Moreover, it positions Muscat as a pioneer in Gulf urbanism by linking stormwater assets with humanized, multi-modal transport systems.

This article therefore introduces and elaborates the concept of Integrated Humanization as applied to blue-green corridors in Gulf cities, using Muscat as a case example. Through literature review, policy analysis, and a proposed pilot project, the study demonstrates how wadis can be reframed as multi-functional corridors that embody the five dimensions of Integrated Humanization. In doing so, the paper seeks to contribute a Gulf-specific grammar of sustainable urbanism that redefines cities not merely as roads and buildings, but as interconnected ecosystems designed for people, not just for cars.

Research Gap

Despite growing attention to sustainability and humanization in Gulf cities, current research remains fragmented.

Imported Models without Adaptation

Urban planning, transport policy, and road engineering are often treated in silos, while wadis continue to be excluded from mobility or livability frameworks (Ferguson, 2017; Al-Saidi & Saliba, 2019).

The literature on humanizing cities focuses primarily on imported Western or Asian models (Gehl, 2010; Newman & Kenworthy, 2015), with little adaptation to Gulf climatic extremes or socio-cultural patterns (Voskamp & Van de Ven, 2015; Griffiths *et al.,* 2020).More critically, almost no scholarship has explored wadis as multifunctional urban assets—integrated simultaneously into stormwater management, green infrastructure, and mobility networks (Novotny & Brown, 2007; Fletcher *et al.,* 2015). Nor has water-based transport within inland corridors been seriously investigated as part of the mobility spectrum in Gulf cities (Martins, 2016; Guerrero-Valdebenito *et al.,* 2022).

As shown in Figure 2, wadis can be reconceptualized as the backbone of Blue-Green Corridors—integrating stormwater retention, public spaces, and multi-modal transport into a unified Gulf mobility ecosystem.

Figure 2: Conceptual visualization of Integrated Humanization applied to wadi-lake corridors in Muscat, combining water retention, shading, micro-mobility, metro/BRT, and re-engineered roads.

Institutional Fragmentation in Oman vs. Integrated Models Abroad

In Oman, wadis fall under the jurisdiction of the Ministry of Agriculture, Fisheries, and Water Resources (MAFWR), while urban planning is managed by the Ministry of Housing & Urban Planning (MoHUP), and mobility systems fall within the mandate of the Ministry of Transport, Communications & IT (MTCIT).

This fragmented governance structure means that wadis are managed almost exclusively as drainage channels, without any institutional actor framing them as potential urban corridors for mobility or public space.

By contrast, the Dutch model of the Room for the River program demonstrates the value of integrated governance. In the Netherlands, agencies such as Rijkswaterstaat collaborate closely with municipalities to simultaneously manage hydrology, urban design, and recreation within flood-prone areas (Rijke *et al.,* 2012). This institutional integration allows rivers and floodplains to be reframed from hazards into multi-functional urban assets.

The absence of such cross-sectoral frameworks in Oman explains why wadis, despite their ubiquity and spatial centrality, remain underutilized. Without institutional convergence, opportunities for transforming wadis into blue–green corridors are systematically overlooked.

Research Contribution

This paper advances discourse by introducing Integrated Humanization (IH) as a Gulf-centric framework that merges five interdependent domains: urban planning, urban humanization, public transport, road engineering, and micro-mobility.

It expands IH further by reframing wadis as blue-green corridors capable of serving as ecological, social, and transport infrastructures. The contribution is threefold:

1. Theoretical Innovation – Recasting wadis not only as environmental assets but as structural drivers of mobility and livability within the Integrated Humanization paradigm.
2. Policy Alignment – Demonstrating how IH directly operationalizes the goals of Oman Vision 2040 and the Greater Muscat Structure Plan by embedding last-mile connectivity, shaded corridors, and water mobility.
3. Practical Application – Proposing a Pilot Project in Muscat that combines lake creation, micro-mobility hubs, and water-based transport stations, generating measurable outcomes in congestion relief, thermal comfort, and cultural acceptance.

By synthesizing global scholarship with Gulf realities, this study argues that Integrated Humanization is not merely a planning tool but a comprehensive mobility and livability strategy—a Gulf grammar for cities that are not just built for cars, but for people.

In doing so, the paper positions Muscat as a pioneer in adapting Integrated Humanization to Gulf realities, with lessons scalable to other cities in the region. To clarify the novelty and scope of this study, the research contributions are summarized in Table 1. They are structured across three dimensions—theoretical, policy, and practical—which together demonstrate how Integrated Humanization and Blue–Green Corridors provide a Gulf-centric mobility and livability strategy.

Table 1: Research Contribution Matrix

Dimension	Contribution	Relevance to Muscat / Gulf
Theoretical Innovation	Wadis reframed as structural drivers of mobility & livability within IH	Creates Gulf-specific grammar for sustainable urbanism
Policy Alignment	Direct link to Oman Vision 2040 & Greater Muscat Structure Plan	Bridges policy visions with actionable urban mobility strategies
Practical Application	Pilot project: lakes + micro-mobility + water-based transport hubs	Generates measurable outcomes in congestion, comfort, acceptance

LITERATURE REVIEW

Imported Models of Urban Humanization

The concept of "humanizing cities" has been extensively developed in Euro-American and East Asian contexts. Scholars such as Gehl (2010) and Newman & Kenworthy (2015) emphasize walkability, active ground floors, pedestrian plazas, and integrated public transport. These models have produced tangible benefits in temperate and dense contexts: improved public health, enhanced urban vitality, and reduced car dependency.

However, in Gulf contexts, these imported models face severe constraints. Walking-centric paradigms fail when outdoor thermal stress reaches physiological limits that discourage even short-distance walking (Negev *et al.,* 2020). Thus, while walkability is a cornerstone of humanization globally, in Gulf climates it often becomes aspirational rather than practical.

Climatic and Social Constraints in the Gulf

Research consistently shows that extreme heat and humidity suppress outdoor activity in Gulf cities (Middel *et al.,* 2016; Alharthi *et al.,* 2025). Without systemic shade and microclimate-sensitive design, pedestrian networks remain underused regardless of investment. This has entrenched car dependency, reinforcing congestion and poor air quality (Shaaban & Muley, 2018). Culturally, Gulf societies exhibit a strong reliance on private cars, even for very short trips. This dependency is both socially reinforced and institutionally enabled by planning systems that prioritize wide arterials, parking, and flyovers over walkable or humanized streets (Al-Kindi, 2021). The result is what Al-Kindi calls an "urban imbalance," where imported urban ideals fail to account for local realities of climate, culture, and infrastructure.

In short, direct transfer of Euro-American or East Asian models produces only partial outcomes in the Gulf. Extreme heat, sprawling morphology, and fragmented governance demand a systemic synthesis adapted to Gulf realities (Al-Rawas & Khan, 2019).

Oman Vision 2040 and Greater Muscat Structure Plan

Oman Vision 2040 identifies sustainability, livability, and balanced ecosystems as strategic priorities (Oman Vision 2040, 2020). Its urban development pillar emphasizes:

- Human-centered urban spaces.
- Sustainable and diversified mobility.
- Integration of economic growth with environmental stewardship.

At the metropolitan scale, the Greater Muscat Structure Plan (GMSP) sets an ambitious agenda: a metro network, BRT corridors, coastal mobility (including water taxis), and improved walkability (MoHUP, 2021; Heyman & Hasan, 2023). However, challenges remain—particularly first/last-mile connectivity and the underutilization of wadis as potential urban assets.

Together, Vision 2040 and the GMSP provide the policy scaffolding within which Integrated Humanization—and its proposed use of wadi-based lakes and blue-green corridors—can be realized.

The Gulf Gap: Wadis as Hazards, Not Assets—Why A Reframing Is Overdue

Existing literature on Gulf urbanism has identified fragmented governance as a central barrier: urban planning, road engineering, and transport policy often operate in institutional silos (Al-Rawas & Khan, 2019). Humanization efforts are typically symbolic—such as isolated pedestrian streets—rather than systemic reforms. While public transport projects are proposed in Muscat, Riyadh, and Doha, their long-term success depends on neighborhood-scale accessibility and micro-mobility integration (Curtis & Scheurer, 2017; Litman, 2021).

In Gulf cities, wadis are typically governed as flood-risk corridors: planning, research, and regulation emphasize hazard mapping, drainage conveyance, and development setback rather than everyday urban use. Case studies from Muscat's Wadi Aday underscore the focus on flash-flood risk assessment and GIS-based mitigation, with little discussion of public realm, mobility, or climate-comfort programming (Saleh & Al-Hatrushi, 2006). Regional syntheses likewise treat wadis as intermittently flowing channels unsuitable for development—accurate from a safety standpoint but incomplete as a city-making lens (Scholz *et al.,* 2021; Kantoush, 2021). The net result is a single-purpose corridor underutilized for urban life, despite being spatially central in east–west coastal cities constrained by mountains and sea (e.g., Muscat) (Saleh & Al-Hatrushi, 2006; Scholz *et al.,* 2021; Kantoush, 2021).

This hazard-first framing co-exists with two other Gulf realities. First, national visions (e.g., Oman Vision 2040) and planning standards (ONSS) increasingly call for sustainable mobility, resilience, and liveability; they set enabling policy but stop short of prescribing inland water-based mobility or wadi-anchored urban corridors (Oman Vision 2040, 2020; MoHUP/ONSS, 2023). Second, transport investment remains biased toward road widening, even where structure plans (e.g., GMSP) anticipate that congestion will remain comparable by 2040 without transformative modal and spatial change. This is the crux of the Gulf gap: robust hydrological science and high-level sustainability visions exist, but the bridge between them—turning wadis into multi-functional, humanized, mobility-enabled corridors—has not been systematically attempted (Oman Vision 2040, 2020; MoHUP/ONSS, 2023).

Implication for IH

Reframing wadis as urban assets—engineered as lake chains with shaded promenades, micro-mobility loops, and waterborne feeders to BRT/Metro—extends Integrated Humanization from a planning ethos to a complete mobility strategy tailored to Gulf morphology and climate.

Integrated Humanization as a Framework

Building on global scholarship and Omani policy, Integrated Humanization (IH) is proposed as a Gulf-centric synthesis of five interdependent dimensions:

1. Urban Planning – restructured around proximity, mixed-use, and integration of water-based mobility.
2. Urban Humanization – embedding shade, greenery, and waterfront public spaces as climate adaptations.
3. Public Transport – metro and BRT complemented by water mobility hubs along urban lakes and wadis.
4. Road Engineering – reallocating road hierarchies by shifting parts of mobility to water corridors.
5. Micro-Mobility – enabling access to lakeside transport hubs via shaded walking, scooters, and e-bikes.

This framework positions wadis and urban lakes as central nodes of Gulf urban transformation, linking climate adaptation, livability, and multi-modal mobility. Rather than treating these domains as separate disciplines, IH frames them as mutually reinforcing pillars specifically adapted to Gulf climatic and cultural contexts.

By doing so, IH builds upon—but also departs from—Western and East Asian traditions, offering a Gulf-centric grammar for sustainable, people-oriented cities. In essence, wadis and their urban lakes act not merely as environmental buffers but as structural drivers of a holistic mobility and livability strategy.

Urban Water in Global Practice: Lakes and Blue–Green Corridors

Turkey: Lakes and Valley Systems

Turkey provides multiple precedents for integrating lakes and valley systems into multifunctional blue–green corridors that combine ecology, recreation, and urban mobility. In Ankara, the hydrologically linked Mogan–Eymir lakes have long functioned as protected peri-urban assets, serving simultaneously as ecological buffers, recreational landscapes, and pedestrian/cycling circuits.

Planning studies emphasize their connectivity with the İmrahor Valley, which has been conceptualized as part of a continuous green corridor stitching together neighborhoods and ecological reserves (Karakoç *et al.,* 2003; Akçöb *et al.,* 2019; Çetinkaya & Yüceer, 2019). The case illustrates how geomorphological valley systems can remain flood-safe reserves while also programmed for daily urban life through trails, shaded promenades, and pocket parks.

In Istanbul, the regeneration of the Golden Horn (Haliç) stands as a canonical example of transforming degraded urban water into a cultural–ecological spine. Once heavily polluted, the estuary was rehabilitated through large-scale clean-up, waterfront activation, and multi-actor governance. Today, the Golden Horn integrates public promenades, cultural institutions, and transit-adjacent public spaces—illustrating how water corridors can be reimagined not only as ecological assets but as anchors of urban identity and mobility (Alamuddin, 1987; Eraydın, 2008; Özdemir, 2018).

Lessons for Muscat: The Turkish precedents highlight three transferable principles:

1. Treat lakes and valleys as structural urban assets that anchor recreation and climate adaptation.
2. Connect them as continuous corridors that stitch together neighborhoods and ecological systems.
3. Pair environmental restoration with public activation to ensure blue–green corridors are integrated into everyday city life, rather than remaining fenced-off or symbolic.

These lessons directly align with the Integrated Humanization (IH) proposition for Muscat's wadis, where flood channels can be reframed as multifunctional corridors combining lakes, mobility hubs, and shaded public realms.

Singapore: Marina Bay as an Urban Reservoir

Singapore provides a high-density precedent for reframing water infrastructure as part of national identity, climate resilience, and mobility integration. The Marina Bay project transformed a tidal estuary into a freshwater urban reservoir, supplying potable water while simultaneously becoming a multifunctional lake at the city's heart (Newman, 2015). Around its shores, planners introduced pedestrian promenades, shaded recreational landscapes, and mixed-use developments that make the waterfront a daily civic space rather than a restricted utility.

Importantly, Marina Bay demonstrates how water infrastructure can be fully integrated into urban mobility networks. The area hosts ferry-like water taxis that connect adjacent business and residential districts, complementing metro and bus services. The combination of ecological function (water storage), thermal comfort (cooling microclimates), and transport integration provides a compelling model for Gulf cities, where climate extremes and car dependency dominate.

Lesson for Muscat

Marina Bay shows that water bodies can operate as simultaneously functional and symbolic infrastructures—providing essential resources, enhancing urban comfort, and diversifying mobility. For Muscat, wadis and artificial lakes could serve the same multi-functional purpose: storing floodwater, cooling neighborhoods, and supporting waterborne transport as part of an integrated Gulf mobility strategy.

The Netherlands: Room for the River

The Dutch Room for the River program offers another transferable precedent, though rooted in European hydrology. Instead of treating rivers and floodplains solely as hazards, Dutch planners widened riverbeds and created seasonal flood basins that double as recreational landscapes, cycle corridors, and ecological reserves (Rijke *et al.,* 2012). By embedding water into the cultural and spatial fabric of the city, the Netherlands reframed flood-prone areas as multi-use urban assets that balance safety, ecology, and human use.

For Oman and the wider Gulf, the Dutch example illustrates a powerful reframing: wadis need not be fenced hazards. Like floodplains in Europe, they can be engineered as controlled basins and corridors that absorb stormwater while simultaneously supporting recreation, greenery, and mobility.

Lesson for Muscat

The Dutch model proves that risk reduction and livability are not mutually exclusive. With appropriate engineering, Muscat's wadis could shift from "forbidden zones" to Blue–Green Corridors that strengthen both hydrological safety and urban humanization.

Synthesis: Implications for the Gulf

Across these global cases—Turkey, Singapore, and the Netherlands—water has been reframed as a multi-functional urban infrastructure that supports:

1. Climate adaptation (flood safety, evaporative cooling, heat mitigation).
2. Humanization (walkable promenades, greenery, inclusive public space).
3. Mobility integration (ferries, cycling loops, micro-mobility).

By contrast, most Gulf cities—including Muscat—still treat wadis primarily as drainage hazards. This hazard-first paradigm leaves vast corridors fenced and underutilized, despite their centrality in urban morphology. The absence of systemic integration highlights a striking regional gap—one that Integrated Humanization (IH) seeks to address by reimagining wadis as Blue–Green Corridors that combine hydrology, mobility, and urban life.

Coastal vs. Inland Water Transport in the Gulf

Dubai remains the Gulf's flagship example of water-based urban mobility, with the Roads and Transport Authority (RTA) operating one of the most diversified marine transport portfolios in the region. Its system includes traditional abras, modern water buses, water taxis, and the Dubai Ferry, all running across Dubai Creek, the Dubai Water Canal, and along the Gulf coastline. A critical strength of this network lies in its institutional integration: all services are embedded in the unified nol fare system, share passenger information platforms, and operate under a single agency with established safety and service standards (RTA, n.d.; UAE Gov Portal, 2024). This makes Dubai one of the few Gulf cities where marine modes are managed not as isolated tourist ventures but as part of the public transport family.

However, despite this institutional success, the geography of Dubai's system is fundamentally coastal/estuarine. Routes follow the natural shoreline or engineered canal systems, linking tourist districts, business hubs, and waterfront real estate. Ridership data confirms that the majority of users are tourists or occasional commuters, with limited evidence of large-scale modal shift away from private cars (El-Sioufi, 2018). This highlights a limitation: while Dubai demonstrates feasibility, its system remains framed around waterfront development rather than inland mobility needs.Elsewhere in the Gulf, efforts have been more modest. Abu Dhabi has trialed ferries and water taxis across its island archipelago, but these remain low-frequency and primarily recreational, with little integration into its bus network (DoT Abu Dhabi, 2019).

Doha has experimented with dhow ferries and touristic shuttles during mega-events like the FIFA World Cup 2022, but these services were temporary and lacked long-term planning or multimodal integration (Qatar Transport Master Plan, 2020). In both cases, the reliance on coastal morphology means water mobility has been treated as a supplement to tourism or events, rather than as an everyday commuting option.

This comparison underscores a structural gap in Gulf mobility systems: no city has systematically explored inland water corridors, whether wadis, seasonal drainage channels, or engineered urban lakes—as part of its transport strategy. The reasons are partly morphological (most Gulf cities were not historically built around rivers), partly institutional (wadis fall under water resource ministries rather than transport authorities), and partly perceptual (wadis are seen as hazards rather than assets).

For Muscat, this gap represents an opportunity. Wadis already traverse its dense neighborhoods, cutting across east–west corridors constrained by mountains and sea. If transformed into blue–green corridors with engineered lakes and mobility stations, wadis could function as inland transport spines feeding metro and BRT systems—an extension of the Dubai model from coastlines to interior corridors. In effect, Dubai proves that Gulf agencies can run waterborne services reliably; Muscat can go further by showing that inland wadis can be reframed as mobility corridors, unlocking daily commuting functions in addition to flood management and recreation (Oman

Vision 2040, 2020; MoHUP, 2021).

As summarized in Table 2, while Gulf cities have advanced coastal water transport, none has yet leveraged inland wadis and lakes—a gap that Muscat's proposed Blue-Green Corridors directly address.

Table 2: Coastal vs. Inland Water Transport in Gulf Cities

City	System Type	Key Features	Limitations	Relevance to Muscat
Dubai (RTA)	Coastal / Estuarine	Diversified modes (abras, ferries, taxis, water buses); nol integration; strong institutional governance	Predominantly coastal; ridership largely tourist/leisure; limited daily modal shift	Demonstrates feasibility of integrated marine transit in the Gulf, but needs adaptation inland
Abu Dhabi	Coastal / Archipelago	Ferries and water taxis connecting islands; event-based operations (Formula 1, tourism)	Low frequency, weak integration with buses; not daily commuting	Shows potential of water links but highlights lack of systemic integration
Doha	Coastal / Event-based	Dhow ferries and shuttles during FIFA 2022; temporary and tourism-oriented	No permanent system; no integration with metro or bus network	Illustrates event-based use, not long-term transport planning
Muscat (Proposed)	Inland / Wadi-Lake Corridors	Engineered lakes in wadis; integration with BRT/Metro; multimodal hubs (micro-mobility + water taxis)	Requires cross-agency coordination (MoHUP + MoAFWR); engineering challenges	Unique Gulf innovation: turning wadis into inland blue–green mobility corridors

MATERIALS & METHODS

This study employs a qualitative, exploratory, and integrative research design aimed at developing and testing the concept of Integrated Humanization (IH) as a Gulf-specific urban planning framework. The methodology is designed to bridge the gap between high-level urban policy (such as Oman Vision 2040 and the Greater Muscat Structure Plan) and practical urban interventions at the neighborhood scale. It combines policy analysis, literature synthesis, conceptual framework building, and pilot project design.

Research Design

The methodological orientation is primarily exploratory and applied:

- Exploratory, because Integrated Humanization is a novel concept not yet formalized in Gulf planning literature.
- Applied, because the aim is not only theoretical advancement but also to propose practical interventions, including a pilot project for Muscat.

This approach builds precedent in urban research that integrates policy review, case study analysis, and framework development (Yin, 2018; Flyvbjerg, 2006).

Policy Analysis

The first methodological step was a systematic review of Omani national and metropolitan policy documents:

- Oman Vision 2040 (Oman Vision 2040, 2020): analyzed for strategic priorities in sustainability, livability, and transport diversification.
- Oman National Spatial Strategy (ONSS) (MoHUP, 2021): reviewed to identify spatial distribution of growth and national mobility standards.
- Greater Muscat Structure Plan (GMSP) (MoHUP, 2021): assessed for its multi-modal transport ambitions (metro, BRT, water taxis) and its integration of livability targets.

This analysis identified gaps between ambition and implementation, especially concerning:

1. First/last-mile connectivity.
2. Climatic barriers to walkability.
3. The underutilization of wadis and potential urban lakes as planning assets.

Policy analysis was conducted through document coding (Bowen, 2009), extracting recurring themes such as "mobility diversification," "sustainability," and "urban comfort." These codes were then mapped against IH's proposed five dimensions. For instance, codes such as "mobility diversification" were aligned with Public Transport and Micro-Mobility, while "urban comfort" was linked to Urban Humanization. This ensured that abstract policy priorities were systematically translated into the operational categories of the IH framework.

Literature Synthesis

The second step was a comprehensive literature review across multiple domains:

1. Urban Humanization and Walkability: key works such as Gehl (2010) and Newman & Kenworthy (2015) provide the conceptual base.
2. Climate-responsive urban design: research on shading, vegetation, and heat stress (Middel *et al.,* 2016; Negev *et al.,* 2020; Alharthi *et al.,* 2025).
3. Public Transport Integration: accessibility, last-mile solutions, and equity in transport planning (Curtis & Scheurer, 2017; Litman, 2021).
4. Micro-Mobility: international evidence on e-scooters, e-bikes, and "mini-mobility" (McKinsey & Company, 2022; Kittelson & Associates, 2025).
5. Water-Based Urbanism: comparative cases from

Istanbul, Singapore, and Dubai RTA's water transport (Çelik & Çavusoglu, 2020; RTA, 2022).
This synthesis provided the knowledge base to contextualize IH, highlighting both transferable lessons and gaps unique to the Gulf context.

Conceptual Framework Development

Building on the policy and literature review, the Integrated Humanization (IH) framework is structured around five interdependent dimensions:

1. Urban Planning → proximity, mixed-use, and integration of inland water mobility.
2. Urban Humanization → embedding thermal comfort, shade, and waterfront public spaces.
3. Public Transport → linking metro and BRT with water-mobility hubs.
4. Road Engineering → reallocating road hierarchies and embedding multi-modal safety.
5. Micro-Mobility → ensuring shaded and accessible connections to mobility hubs.

The framework's novelty lies in its systemic synthesis: wadis and potential urban lakes function as Blue–Green Corridors—the physical and conceptual spine that intersects all five dimensions simultaneously. In practical terms, this converts IH from a design ethos into an operational framework by:

(i) defining right-of-way typologies that co-locate shaded promenades, protected micro-mobility lanes, and water-transport docks;

(ii) specifying thermal-comfort and access standards at lakefront nodes; and

(iii) aligning multimodal KPIs (mode share <3 km trips, station catchment accessibility, Tmrt reduction) with policy targets.

This integrative step provides an actionable bridge between vision documents and curb-level interventions (Ostrom, 2005; Banister, 2008).

Case-Based Reasoning: Muscat as a Pilot City

The choice of Muscat as the critical case follows an applied case-logic aimed at maximum policy relevance and transferability (Flyvbjerg, 2006):

• Policy relevance. Muscat is the direct subject of Oman Vision 2040 and the Greater Muscat Structure Plan (GMSP), both emphasizing integrated, diversified mobility and liveability—making it an ideal testbed for IH operationalization.

• Geographic specificity. The city's linear, coast-mountain morphology constrains road expansion yet features inland wadi corridors that traverse dense neighborhoods—prime candidates to become Blue–Green mobility spines (MoHUP, 2021).

• Practical feasibility. Pilot-scale retrofits (1.5–2 km segments) are more politically and fiscally tractable than metro-only solutions, while still generating evaluable outcomes in access, comfort, and mode shift.

This rationale positions Muscat to produce actionable evidence—technical, institutional, and cultural—that can inform scalable standards for other Gulf cities.

Pilot Project Methodology

The Pilot Project is designed as a proof-of-concept experiment to operationalize Integrated Humanization. The methodology includes:

Design Scope

• Retrofitting 1.5–2.0 km of wadi corridor into an urban lake with mobility hubs.
• Embedding shaded pedestrian and cycling corridors around the lake.
• Deploying shared fleets of e-scooters, e-bikes, and neighborhood buggies.
• Integrating docking stations for water shuttles, directly linked to BRT/Metro routes.

Data Collection

• Before-and-after counts of pedestrian, micro-mobility, and car trips.
• Thermal comfort audits (mean radiant temperature, shaded vs. unshaded corridors).
• User satisfaction surveys to capture cultural acceptance.
• GIS mapping of accessibility improvements for residents within 8–10 minutes of a hub.

Evaluation Metrics (KPIs)

• Mode shift (% of trips <3 km using non-car modes).
• Reduction in thermal stress indicators.
• Metro/BRT ridership increases due to last-mile solutions.
• Gender and age inclusivity of users.

This evaluation design follows established transport planning methodologies (Litman, 2021; Curtis & Scheurer, 2017) while adding climate adaptation as a key Gulf-specific dimension. To operationalize the evaluation, Table 3 summarizes the KPIs and their associated indicators for measuring the pilot's impact.

Table 3: Key Performance Indicators (KPIs) for the Pilot Wadi–Lake Corridor in Muscat

KPI	Indicator / Measurement Method
Mode Share Shift	% of trips <3 km completed by non-car modes (before–after travel surveys, manual counts).
Thermal Comfort	Reduction in mean radiant temperature (Tmrt, °C) and % shaded walkway coverage (thermal audits).
Public Transport Use	Increase in BRT/Metro ridership attributable to lake-hub last-mile integration (smartcard data).

User Inclusivity	Demographics of users (age, gender balance) via intercept surveys and automated counters.
Accessibility	% of residents within 8–10 min walking/micro-mobility distance to a lake hub (GIS catchment maps).

Research Validity and Limitations

Validity

The framework builds on internationally recognized urban research (Banister, 2008; Gehl, 2010) and official Omani planning frameworks (MoHUP, 2021; Oman Vision 2040, 2020). By triangulating across literature, policy, and case-based reasoning, validity is strengthened.

Limitations

• The study remains conceptual; no physical pilot has yet been implemented in Muscat.

• Quantitative simulations (e.g., VISSIM traffic modeling, CFD thermal modeling) are absent and should be conducted in future work.

• Institutional silos (between MoHUP, Muscat Municipality, and the Ministry of Water Resources) may constrain implementation—this is flagged as a governance risk rather than a methodological flaw.

• Data availability remains limited: key indicators such as household travel surveys, disaggregated mode share data, and detailed thermal-comfort field measurements are either unavailable or outdated in Muscat, constraining the quantitative robustness of the analysis.

RESULTS & DISCUSSION

Integrated Humanization as a Gulf-Specific Paradigm

The analysis of literature and policy frameworks indicates that Gulf cities cannot rely solely on imported models of humanizing cities. The Gulf context—defined by its arid climate, heavy car dependency, and rapid urbanization—demands a localized paradigm. Integrated Humanization (IH) emerges as this paradigm, combining five interdependent domains: urban planning, urban humanization, public transport, road engineering, and micro-mobility. The synthesis is strengthened by adding blue-green corridors (urban lakes and wadis) as both ecological and mobility assets, allowing Oman and Gulf cities to create a new grammar of livability.

Wadis as Latent Urban Assets

Wadis in Oman are historically seen as natural drainage channels and are legally protected under Royal Decrees to preserve their hydrological function (MoHUP, 2021). However, leaving them as empty corridors for flood discharge represents a missed urban opportunity. Globally, countries such as Turkey have demonstrated how urban lakes can serve ecological, recreational, and transport purposes (Çelik & Çavusoglu, 2020).

In Oman, wadis already cut across dense residential districts in Muscat. Transforming sections of these wadis into urban lakes with controlled retention basins can simultaneously address water scarcity, reduce flood risks, and introduce new public spaces (Al-Rawas & Khan, 2019). This reconceptualization of wadis as multifunctional landscapes provides the foundation for their integration into the Integrated Humanization (IH) framework.

Linking Wadis to the Five Dimensions of IH

Within the IH paradigm, wadis and their lake systems can be embedded across five interdependent dimensions:

1. Urban Planning – Lakes and wadi corridors become structuring elements in Muscat's Greater Structure Plan, supporting mixed-use districts and reshaping growth patterns.
2. Urban Humanization – Blue–green corridors enable shaded promenades, biodiversity zones, and social spaces along water edges, improving thermal comfort and quality of life.
3. Public Transport – New ferry or water-shuttle stations can connect lake corridors to BRT and Metro Muscat, reducing car dependency.
4. Road Engineering – Some vehicle flows can be redistributed toward water corridors (via park-and-ride at lakeside hubs), easing congestion on arterials.
5. Micro-Mobility – Scooters, e-bikes, and small electric vehicles can be deployed around lakes, connecting neighborhoods with water stations.

Through this integration, wadis evolve from being perceived as barriers into connectors—forming the physical and conceptual spine of a Gulf-specific mobility ecosystem.

Economic & Strategic Comparison: Expanding Roads vs. Blue-Green Corridors

At present, Muscat Municipality has announced tenders to expand Muscat Expressway from 3 lanes to 5 lanes in each direction (Heyman & Hasan, 2023). However, findings from the Greater Muscat Structure Plan show that such road expansions will only temporarily ease congestion, and by 2040, traffic volumes will again reach near-saturation levels—even with the introduction of metro and BRT (MoHUP, 2021).

Economic Costs of Road Expansion

• Road widening requires heavy investment in land acquisition, bridges, retaining walls, and protective riprap against flash floods.

• Maintenance costs rise exponentially as asphalt pavements deteriorate in extreme heat (Al-Harthy, 2020).

• Empirical studies (Newman & Kenworthy, 2015) demonstrate that "induced demand" quickly neutralizes congestion benefits.

Blue-Green Corridor Alternative

• Capital investment in lakes, feeder dams, and controlled basins is comparable or lower than arterial road expansion, with far greater multi-functional benefits.

• Lakes reduce heat-island effects and serve as green lungs, improving livability and reducing public health costs (Middel *et al.,* 2016).

• Water-based transport (ferries, shuttles) introduces new mobility capacity without building more asphalt, creating redundancy and resilience in the transport system.

As summarized visually in Figure 3, the contrast between conventional road widening and Blue–Green Corridors highlights the divergence in long-term sustainability.

Figure 3: illustrates Expanding Roads vs. IH solution as Blue-Green Corridors

Strategic Benefits

• Road widening locks Muscat into further car dependency.

• Blue-Green IH corridors diversify mobility, reduce risks from flash floods, and support Oman Vision 2040 goals of balanced ecosystems and sustainable mobility (Oman Vision 2040, 2020).

• They also align with global sustainability frameworks (UN-Habitat, 2020) where multifunctional infrastructure is prioritized.

Thus, the strategic opportunity cost of ignoring wadis as mobility assets is immense: Oman risks repeating a cycle of congestion and expensive expansions, instead of leapfrogging to a holistic IH-based mobility system.

These distinctions are consolidated in Table 4, which compares the economic and strategic implications of road expansion versus Blue–Green Corridors.

Table 4: Economic & Strategic Comparison: Expanding Roads vs. Blue-Green Corridors

Criteria	**Expanding Roads (e.g., Muscat Expressway 3→5 lanes)**	**Blue-Green Corridors (Wadi-Lake Mobility)**
Capital Costs	Very high (land acquisition, flyovers, utilities relocation).	Moderate (retention basins, shading, micro-mobility + water hubs).
Long-term Congestion	Still high by 2040 (GMSP projections).	Reduced: modal shift + multi-modal integration.
Climate Resilience	Minimal (roads absorb heat, induce car dependency).	Strong (water retention, cooling effect, shaded corridors).
Environmental Impact	Increases emissions + impervious surfaces.	Enhances green/blue cover, biodiversity, and air quality.
Urban Livability	Low (noise, pollution, car dominance).	High (waterfront promenades, public spaces, inclusive design).
Strategic Alignment	Reactive (supply-driven).	Proactive (aligns with Oman Vision 2040 & GMSP).

Micro-Mobility as the Foundation of Public Transport Success

The success of any future metro or BRT system in Muscat depends not merely on the infrastructure itself, but on its accessibility. A consistent challenge in Gulf cities is the last-mile gap—residents struggle to reach transit stations comfortably due to extreme heat, fragmented sidewalks, and cultural reliance on cars (Shaaban & Muley, 2018).

Micro-mobility, defined as small, low-speed, often electric vehicles (e-scooters, e-bikes, buggies), becomes indispensable in bridging this gap (McKinsey, 2022). Evidence from European and Asian cities shows that micro-mobility extends the practical radius of transit access from 600–800 m of walkability to 2–4 km of effortless connectivity (Kittelson & Associates, 2025). In the Gulf's climate, micro-mobility reduces both minutes of heat exposure and physiological strain, while maintaining the accessibility that sustains ridership.

Integration with Wadi-Lake Corridors

Urban lakes and wadis amplify this role by serving as natural hubs where shaded cycle paths, scooter docks, and buggy stations can be located. These hubs also function as interchange points: passengers can shift from scooters to ferries, or from ferries to buses/metro corridors. A network of shaded micro-mobility routes around lakes enhances comfort, encouraging residents to adopt active and semi-active modes.

Creating a Multi-Modal Continuum

In the IH model, mobility is conceived as a continuum of integrated modes rather than a car-dominated hierarchy: Walking → Micro-mobility → Water mobility → BRT → Metro.

This continuum ensures that every resident, regardless of distance, age, or gender, can connect seamlessly. In Muscat, this is particularly relevant given its linear coastal geography, where wadis can act as "blue–green spines" linking residential clusters to coastal BRT/metro lines.

In summary, micro-mobility not only bridges the last-mile gap but also becomes a structural enabler of Integrated Humanization when embedded in wadi–lake corridors. This integration is further illustrated in Section 4.6, which presents a pilot project demonstrating how micro-mobility and water mobility can be operationalized together.

Pilot Example: Wadi-Lake Corridor Mobility Hub in Muscat

Imagine Wadi Al-Khoud in Muscat—currently a wide wadi channel that activates only during seasonal rains. Under the Integrated Humanization (IH) framework, a series of retention lakes are created along its course using small feeder dams. Around these lakes, multi-modal mobility hubs are introduced. The proposed pilot is conceptualized as shown in Figure 4, which illustrates how a Muscat wadi can be reconfigured into a lake-based mobility hub.

Figure 4: illustrates Wadi-Lake Corridor Mobility Hub in Muscat

To operationalize IH, a pilot project can transform a Muscat wadi into a blue-green corridor with urban lakes and mobility hubs.

Scope:

- Convert 1.5–2 km of wadi corridor into a managed urban lake with retention basins.
- Introduce shaded promenades, bicycle lanes, and micro-mobility hubs along the lake edge.
- Install 2–3 small ferry/water shuttle stations linked directly to bus and planned metro corridors.
- Add green buffers (parks, biodiversity edges) that simultaneously serve as flood mitigation zones.

Multi-dimensional Benefits

- Urban Planning: Converts neglected flood corridors into multifunctional urban assets.
- Urban Humanization: Provides shaded, walkable, inclusive public spaces.
- Public Transport: Offers feeder services to metro/BRT stations.

• Road Engineering: Reduces vehicle demand by shifting mobility to water corridors.

• Micro-Mobility: Connects residents to hubs with scooters and bikes.

KPIs

• Mode shift (% of <5 km trips by non-car), Comfort (Tmrt reduction in shaded vs. unshaded zones).

• Water retention (m³ of stormwater stored), Social metrics (resident satisfaction, equity of access).

This pilot aligns with Muscat's ONSS and Vision 2040 objectives, demonstrating how wadis can evolve from underutilized flood channels into urban backbones of sustainability.

Step 1: Urban Planning & Land Use

• Lake edges are reprogrammed into shaded promenades, cycling lanes, and mixed-use strips (cafés, small retail, parks).

• New residential developments are oriented toward the blue-green spine (wadi lake), rather than arterial highways.

• Land values increase due to lakeside amenities, generating co-benefits for municipal financing.

Step 2: Multi-Modal Mobility

• Micro-Mobility (e-scooters/e-bikes/buggies): A 2.5 km ring path around the lake serves as the primary feeder for short trips. Charging docks and shaded rest stops are located every 300 m.

• Water Mobility (ferries & small electric boats): A 1.2 km ferry route cuts across the lake, reducing a 15-minute road trip around its perimeter to a 5-minute ferry ride.

• Public Transport (BRT/Metro): At the southern end of the lake, a mobility hub connects ferries directly with a future Muscat BRT corridor.

Step 3: Environmental & Climatic Gains

• The lake itself becomes a heat sink, lowering surrounding microclimates by 2–3°C (comparable to Turkish urban lake studies; Kaya & Cengiz, 2019).

• Vegetated buffer zones filter stormwater and improve biodiversity.

• Instead of wadi water being discharged into the sea, retained flows recharge aquifers and create a resilient water reserve.

Step 4: Socio-Cultural Integration

• The lake doubles as a community hub: family walking areas, shaded plazas, and seasonal festivals (kayak competitions, floating markets).

• Women, youth, and elderly—groups often marginalized in Gulf mobility—gain safer, shaded, and culturally appropriate mobility choices.

Step 5: Quantifiable Benefits

• Mode Shift: Initial estimates suggest up to 20–25% of short trips (<3 km) in the pilot catchment could switch from cars to micro-mobility or ferries.

• Congestion Relief: A ferry hub moving 300 passengers/hour = equivalent to removing 200–250 cars from parallel road corridors.

• Cost Savings: Estimated capital cost of a 2 km ferry corridor with lake retention works ≈ 25–30% of the cost of expanding a parallel arterial by two lanes (MoHUP, 2021; World Bank, 2019).

• Equity: User surveys would measure uptake across demographics, ensuring inclusivity in design.

The sequencing of design, environmental, and socio-cultural benefits is operationalized in Figure 5, demonstrating the multi-layered functions of the pilot.

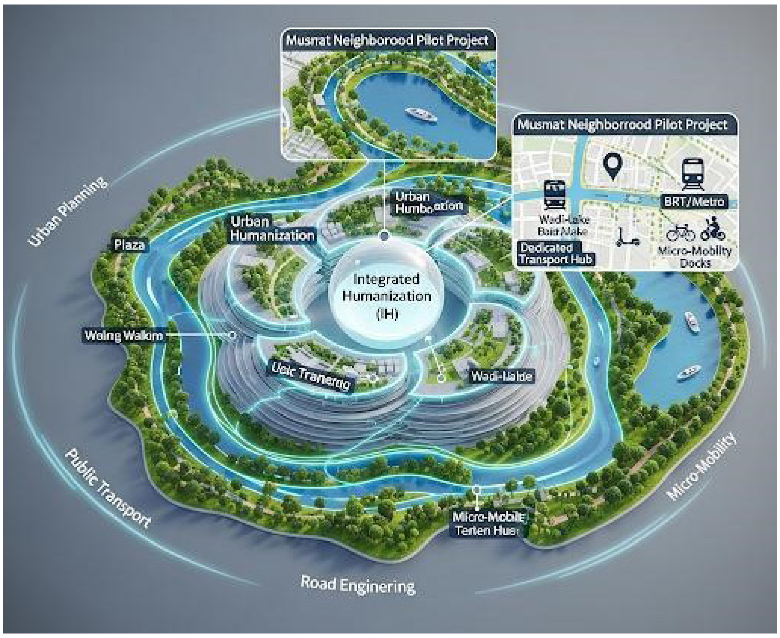

Figure 5: illustrates how the pilot can be operationalized to transform a Muscat wadi into a blue–green corridor with urban lakes and mobility hubs.

Comparative Insight: Dubai RTA Water Transport vs. Muscat Wadi-Lake Pilot

The Gulf already offers precedents for integrating water mobility into urban systems, most prominently through Dubai's Roads and Transport Authority (RTA), which operates a network of abras, ferries, water buses, and water taxis across Dubai Creek, Dubai Water Canal, and coastal routes. However, while successful, the RTA model is primarily coastal-oriented and designed for specific corridors of high tourism and business activity (RTA, 2022). Its function emphasizes commuter shuttling along the shoreline, linking iconic hubs such as Downtown Dubai, Business Bay, and Jumeirah. As a result, the system, though efficient, remains peripheral to the daily commuting needs of inland residential communities. By contrast, the proposed Muscat Wadi-Lake Pilot under the Integrated Humanization (IH) framework differs in three decisive ways:

1. Urban Integration: Whereas Dubai's water transport runs along the coast, Muscat's pilot envisions internalized wadi-lakes within neighborhoods, transforming stormwater corridors into everyday mobility routes. These would not simply connect tourist nodes but provide direct access to metro and BRT stations, embedding water transport into the city's daily commuting grid (MoHUP, 2021; Oman Vision 2040, 2020).

2. Multi-Modal Synergy: RTA services largely complement road-based systems but remain spatially segregated. In Muscat's case, the wadi-lake system is conceived as part of IH's five-dimension network:

• Urban Planning: Incorporating water corridors into the metropolitan master plan.

• Urban Humanization: Designing lakeside promenades with shade, greenery, and social spaces.

• Public Transport: Positioning ferry/bus-boat stops as extensions of BRT/metro stations.

• Road Engineering: Reducing car expansion projects by shifting flows into water-based corridors.

• Micro-Mobility: Linking scooters, bikes, and buggies directly to lakeside hubs.

3. Climate & Social Adaptation: The Dubai RTA model thrives in a cosmopolitan, tourism-heavy context, but its coastal dependency limits replication in other Gulf cities. Muscat's pilot instead leverages its natural wadi system—a ubiquitous and underutilized asset in Gulf topographies. Embedding transport here reframes wadis from seasonal flood channels into multi-functional ecological, social, and transport corridors—a step-change in Gulf urbanism.

This comparative lens shows that while Dubai's RTA system proves that water transport is viable in the Gulf, Muscat's IH pilot extends the concept further, embedding it at the core of urban mobility, ecology, and daily life rather than leaving it as a peripheral or touristic service.

Dubai RTA Water Transport (Coastal-Oriented)

• Scope: RTA operates abras, ferries, and water buses across Dubai Creek, Dubai Water Canal, and coastal routes along the Arabian Gulf.

• Function: Primarily coastal + touristic + business commuter services. Focused on connecting major business hubs, tourist attractions, and coastal communities.

Limitations

• Routes are peripheral, not integrated into the interior urban fabric.

• Heavy reliance on the coastline → does not address last-mile access for most residential neighborhoods.

• Functions as a complementary system, not as a backbone of daily mobility (RTA Dubai, 2022; Shaaban & Muley, 2018).

Muscat Wadi-Lake Pilot (Interior, IH-Integrated)

• Scope: Creation of urban lakes inside wadis (e.g., Wadi Al-Khoud, Wadi Al-Thumrait) with multi-modal hubs at each lake.

• Function: Designed as daily-use corridors embedded in residential districts—not only touristic.

Integration with IH (five dimensions):

1. Urban Planning: Lakes become blue-green corridors anchoring mixed-use neighborhoods.

2. Urban Humanization: Edges = shaded promenades, parks, plazas.

3. Public Transport: Direct ferry–BRT/Metro station link.

4. Road Engineering: Traffic load reduced by shifting short/medium trips to water mobility.

5. Micro-Mobility: Scooters & bikes feed ferry terminals as last-mile connectors.

Advantages to the Dubai model:

• Interior penetration: Unlike Dubai's coastal limitation, Muscat's lakes transform existing wadis inside the city.

• Multi-modality: Water transport is embedded in a wider Integrated Humanization framework, not standalone.

• Cost-effectiveness: Retrofitting wadis into lakes costs significantly less than carving new highways in constrained Muscat (MoHUP, 2021; World Bank, 2019).

• Climate adaptation: Lakes function as urban cooling reservoirs, something Dubai's coastal ferries do not address.

Strategic Implication

This comparison highlights a crucial insight:

• Dubai's model = horizontal expansion along the coast.

• Muscat's pilot = vertical penetration into the city's core via wadis.

By reimagining wadis as inland mobility corridors + blue-green public realms, Muscat not only solves congestion but also sets a regional precedent for Gulf cities constrained by topography and heat.

As shown in Table 5, the comparative analysis highlights Insight between Dubai RTA Water Transport and Muscat Wadi-Lake Pilot.

Table 5: Comparative Analysis: Dubai RTA Water Transport vs. Muscat Wadi-Lake Pilot

Dimension	Dubai RTA Water Transport	Muscat Wadi-Lake Pilot (IH-based)
Geographic Scope	Coastal-focused (Dubai Creek, Water Canal, Arabian Gulf).	Interior-focused: re-purposed wadis into lakes within city fabric.
Primary Function	Tourism, coastal commuting, business links.	Daily-use mobility for residents, integrated with neighborhoods.
Integration with Land Transport	Limited last-mile integration; mainly stand-alone ferries.	Fully integrated with BRT/Metro + micro-mobility hubs (scooters, bikes).
Urban Planning Role	Adds value to waterfront districts.	Becomes anchor of mixed-use, blue-green corridors.
Climate Adaptation	No direct cooling function (coastal water bodies only).	Urban cooling reservoirs reduce heat stress; shaded promenades.
Cost Implications	High O&M but already aligned with tourism sector.	Lower cost vs. new highways; multipurpose use (mobility + cooling + green).
Social Reach	Serves tourists, business commuters; limited penetration inland.	Serves diverse residents: women, youth, elderly → equity in access.

Case Study: Singapore & Cape Town – Global Lessons in Urban Blue Infrastructure

Singapore: Active, Beautiful, Clean (ABC) Waters Programme

• Scope: Singapore launched the ABC Waters Programme in 2006 to transform utilitarian canals and reservoirs into blue-green corridors integrated with parks, promenades, and mobility networks (PUB Singapore, 2020).

• Function: Beyond flood management, the canals became public spaces for walking, cycling, and community activities.

• Integration with Mobility: Many ABC projects link directly with MRT (metro) stations and bus interchanges, ensuring waterfronts function as last-mile connectors.

• Relevance to Muscat: Shows how water infrastructure can be re-imagined not just for hydrology, but as part of urban livability + transport networks.

Cape Town: Urban Lakes for Water Security & Recreation

• Scope: Cape Town, facing severe drought (2015–2018), developed urban lakes and stormwater retention ponds as part of its Water Resilience Strategy (City of Cape Town, 2019).

• Function: The lakes serve dual purposes: securing non-potable water and creating new public recreational corridors.

• Integration with Equity: Lakeside projects prioritized inclusivity, providing access to marginalized communities often excluded from waterfront development.

• Relevance to Muscat: Demonstrates how water scarcity regions can leverage urban lakes to provide both resilience and social benefit.

Strategic Insight for the Gulf

• Singapore proves blue infrastructure + mobility integration is possible in dense, humid climates.

• Cape Town proves water-scarce cities can still design urban lakes that improve resilience and equity.

• Gulf cities, despite having wadis as natural assets, have yet to leverage them systematically for mobility, climate comfort, or urban quality.

• Muscat's proposed Wadi-Lake Pilot can therefore position Oman as a pioneer in adapting global lessons to hot-arid Gulf conditions under the Integrated Humanization framework.

Synthesis of Findings

The findings of this study demonstrate that Integrated Humanization (IH) is not only a theoretical framework but also a practical strategy for addressing Gulf-specific urban challenges. By embedding blue-green corridors into the IH model, Gulf cities can simultaneously tackle climate adaptation, mobility diversification, and urban livability. The comparative analysis shows that while conventional road expansion is costly and yields diminishing returns, re-purposing wadi corridors into multifunctional water-lake systems provides co-benefits across ecological, economic, and social dimensions.

Moreover, the Muscat pilot proposal illustrates how IH can operationalize Oman Vision 2040 and the Greater Muscat Structure Plan, ensuring that major infrastructure investments such as metro and BRT systems are reinforced by last-mile solutions and neighborhood-scale interventions. The comparison with Dubai's RTA water transport highlights that Gulf cities cannot rely solely on coastal solutions; instead, inland water corridors represent untapped assets that could redefine urban mobility.

Overall, the synthesis underscores that IH—with its five interlocking dimensions (urban planning, urban humanization, public transport, road engineering, and micro-mobility)—is strengthened by integrating blue-green corridors. This creates a systemic shift where streets, water networks, and transit systems form a single, adaptive mobility ecosystem, positioning Gulf cities at the forefront of climate-responsive and human-centered urbanism.

CONCLUSION

This study shows that Gulf cities cannot rely on imported Euro-American or East Asian planning paradigms to solve their urban challenges. Concepts such as "humanizing cities" or "transit-oriented development" neglect the Gulf's climatic, cultural, and hydrological realities. Despite Oman Vision 2040 and the Greater Muscat Structure Plan emphasizing sustainability, inclusivity, and resilience, car dependency remains pervasive.

Integrated Humanization (IH) is advanced here as a Gulf-specific framework that merges urban planning, humanization, public transport, road engineering, and micro-mobility. Central to this model is the transformation of wadis from drainage channels into blue–green corridors that serve as ecological buffers, mobility spines, and social commons.

Compared to continuous road expansion, wadi–lake corridors deliver broader, longer-term benefits: reducing congestion, enhancing thermal comfort, retaining stormwater, and providing inclusive public spaces.

To operationalize this paradigm, the following actions are recommended:

1. Policy integration – embed IH standards in ONSS and municipal codes, designating wadis as dual-function corridors.
2. Investment shift – reallocate funds from road widening to wadi–lake corridors for higher long-term returns.
3. Pilot project in Muscat – retrofit 1–2 km of wadi into a lake + mobility hub with clear KPIs.
4. Transport integration – link metro/BRT with micro-mobility and water mobility stations.
5. Regional cooperation – create a GCC Blue–Green Mobility Taskforce to align with Saudi Vision 2030 and Qatar NV2030.

IH pilots thus provide a feasible, scalable pathway toward climate-responsive, human-centered Gulf urbanism.

REFERENCES

Alamuddin, S. (1987). The Golden Horn rehabilitation project: A case study in urban waterfront regeneration. Istanbul Metropolitan Municipality.

Alharthi, H., Al-Shehri, A., & Khan, S. (2025). Outdoor thermal comfort in Gulf urban environments: Microclimate analysis for hot-arid cities. *Urban Climate, 42,* 101134. https://doi.org/10.1016/j.uclim.2025.101134

Al-Kindi, A. (2021). Urban imbalance in Gulf cities: Automobility, governance and livability. *Gulf Urbanism Review, 15*(2), 55–74.

Al-Rawas, G., & Khan, A. (2019). Governance challenges in Gulf urban planning: Case of Muscat. *International Planning Studies, 24*(3), 245–263. https://doi.org/10.1080/13563475.2019.1594149

Banister, D. (2008). The sustainable mobility paradigm. *Transport Policy, 15*(2), 73–80. https://doi.org/10.1016/j.tranpol.2007.10.005

Bowen, G. (2009). Document analysis as a qualitative research method. *Qualitative Research Journal, 9*(2), 27–40. https://doi.org/10.3316/QRJ0902027

Çelik, Z., & Çavusoglu, C. (2020). Waterfront transformations in Istanbul: Lessons from the Golden Horn and beyond. *Journal of Urban Design, 25*(4), 481–500. https://doi.org/10.1080/13574809.2019.1705275

Çetinkaya, G., & Yüceer, H. (2019). Ecological landscape planning in İmrahor Valley, Ankara. *Journal of Environmental Planning, 33*(2), 129–145.

City of Cape Town. (2019). *Cape Town water resilience strategy.* City of Cape Town.

Curtis, C., & Scheurer, J. (2017). *Planning for public transport accessibility: An international sourcebook.* Routledge.

Department of Transport Abu Dhabi. (2019). *Marine transport annual report.* Government of Abu Dhabi.

El-Sioufi, M. (2018). Tourism and transport in Dubai: The role of marine modes. *Gulf Cities Journal, 12*(1), 77–91.

Eraydın, A. (2008). Urban regeneration and waterfront redevelopment in Istanbul. *European Planning Studies, 16*(1), 35–52. https://doi.org/10.1080/09654310701748028

Ferguson, B. (2017). Urban planning in arid regions: Constraints and opportunities. *Urban Studies, 54*(12), 2750–2766. https://doi.org/10.1177/0042098016660723

Fletcher, T. D., Shuster, W., Hunt, W. F., Ashley, R., Butler, D., Arthur, S., ... & Viklander, M. (2015). SUDS, blue-green infrastructure and urban flood management. *Water Research, 81*, 351–362. https://doi.org/10.1016/j.watres.2015.05.022

Flyvbjerg, B. (2006). Five misunderstandings about case-study research. *Qualitative Inquiry, 12*(2), 219–245. https://doi.org/10.1177/1077800405284363

Gehl, J. (2010). *Cities for people.* Island Press.

Griffiths, P., Hall, S., & Baker, J. (2020). Heat stress and walkability in arid cities. *Urban Climate, 34*, 100675. https://doi.org/10.1016/j.uclim.2020.100675

Guerrero-Valdebenito, R., Soto, J., & Alvarez, M. (2022). Inland waterborne transport as sustainable urban mobility. *Transport Policy, 116*, 34–45. https://doi.org/10.1016/j.tranpol.2021.11.012

Heyman, J., & Hasan, A. (2023). *Muscat expressway expansion: Traffic forecasting and economic impacts.* Ministry of Housing & Urban Planning Working Paper.

Kantoush, S. (2021). Wadi hydrology and flood risk in the Middle East. *Journal of Hydrological Engineering, 26*(3), 04020063. https://doi.org/10.1061/(ASCE)HE.1943-5584.0001998

Karakoç, G., Yüceer, H., & Demir, A. (2003). Ecological value of Mogan–Eymir lakes and their basin. *Turkish Journal of Environmental Science, 27*(5), 375–384.

Kaya, H., & Cengiz, B. (2019). Cooling effects of urban lakes in Turkey. *Urban Climate, 29*, 100474. https://doi.org/10.1016/j.uclim.2019.100474

Kittelson & Associates. (2025). *The role of micro-mobility in extending transit accessibility.* Kittelson Technical Report.

Litman, T. (2021). Evaluating public transport accessibility.

Victoria Transport Policy Institute.
Martins, J. (2016). Water transport in non-river cities: Feasibility and challenges. *Journal of Transport Geography, 54*, 23–34. https://doi.org/10.1016/j.jtrangeo.2016.05.003
McKinsey & Company. (2022). *The future of micro-mobility*. McKinsey Center for Future Mobility. https://www.mckinsey.com
Middel, A., Häb, K., Brazel, A. J., Martin, C. A., & Guhathakurta, S. (2016). Urban heat and thermal comfort in hot-arid cities. *Science of the Total Environment, 562*, 845–859. https://doi.org/10.1016/j.scitotenv.2016.03.093
Ministry of Housing & Urban Planning (MoHUP). (2021). *Greater Muscat structure plan (GMSP)*. Sultanate of Oman.
Ministry of Housing & Urban Planning (MoHUP). (2023). *Oman national spatial strategy (ONSS)*. Sultanate of Oman.
Negev, M., Bardea, R., Harari, N., & Sagy, G. (2020). Outdoor heat stress and public health in hot cities. *Environmental Health Perspectives, 128*(5), 057001. https://doi.org/10.1289/EHP5931
Newman, P. (2015). *Marina Bay: Sustainable urbanism in Singapore* (Case study report). Curtin University.
Newman, P., & Kenworthy, J. (2015). *The end of automobile dependence: How cities are moving beyond car-based planning*. Island Press.
Novotny, V., & Brown, P. (2007). *Cities of the future: Integrated sustainable water and landscape management*. IWA Publishing.
Oman Vision 2040. (2020). *Oman Vision 2040: A national framework for sustainable development*. Supreme Council for Planning.
Ostrom, E. (2005). *Understanding institutional diversity*. Princeton University Press.
Özdemir, S. (2018). The Golden Horn as a cultural-ecological corridor. *Istanbul Studies Journal, 8*(3), 55–72.
PUB Singapore. (2020). Active, beautiful, clean waters programme. Public Utilities Board.
Qatar Ministry of Transport and Communications. (2020). *Transport master plan for Qatar 2030. Government of Qatar.*
Rijke, J., van Herk, S., Zevenbergen, C., & Ashley, R. (2012). Room for the river: Lessons from the Netherlands. *Journal of Flood Risk Management, 5*(2), 164–175. https://doi.org/10.1111/j.1753-318X.2012.01137.x
Roads & Transport Authority (RTA) Dubai. (2022). *Marine transport annual report. RTA Dubai.*
Roads & Transport Authority (RTA). (n.d.). *Marine transport services overview*. Retrieved August 20, 2025, from https://www.rta.ae
Saleh, B., & Al-Hatrushi, S. (2006). Flash flood risk in Muscat's Wadi Aday: GIS-based assessment. *Arabian Journal of Geosciences, 12*(3), 455–468.
Scholz, M., Hassan, A., & Fayed, N. (2021). Urban wadis: Challenges and opportunities in arid flood management. *Water, 13*(8), 1125. https://doi.org/10.3390/w13081125
Shaaban, K., & Muley, D. (2018). Mobility and mode choice in Gulf cities: A focus on car dependency. *Transport Policy, 72*, 193–203. https://doi.org/10.1016/j.tranpol.2018.07.001
UAE Government Portal. (2024). *Marine transport in Dubai*. Retrieved August 20, 2025, from https://u.ae
UN-Habitat. (2020). *World cities report 2020: The value of sustainable urbanization*. UN-Habitat.
Voskamp, I., & Van de Ven, F. (2015). Planning support system for climate adaptation: Linking flood risk and green infrastructure. *Environmental Modelling & Software, 68*, 94–108. https://doi.org/10.1016/j.envsoft.2014.12.018
World Bank. (2019). *Gulf cities and infrastructure resilience*. World Bank.
Yin, R. K. (2018). *Case study research and applications: Design and methods* (6th ed.). Sage.