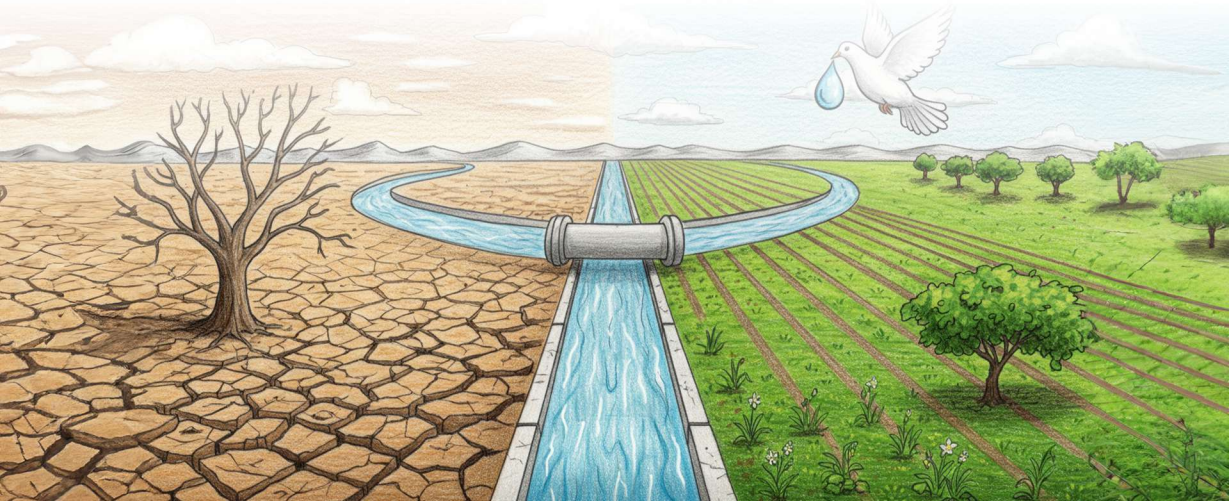
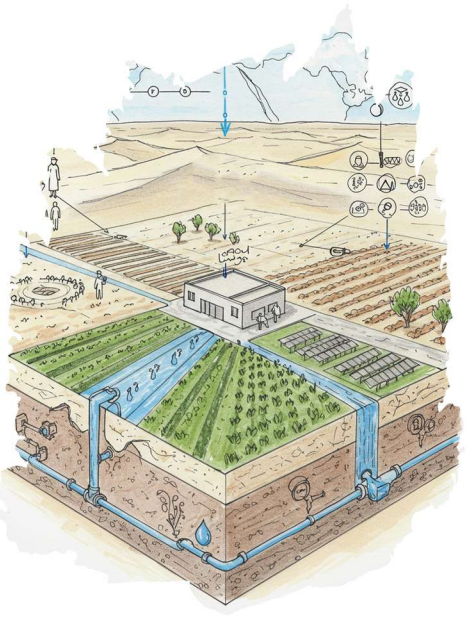
REICHMAN UNIVERSITY, ISRAEL

Water Management as a Tool for Regional Stability in Arid Regions
The Negev Desert as a case study for Middle East and North Africa.

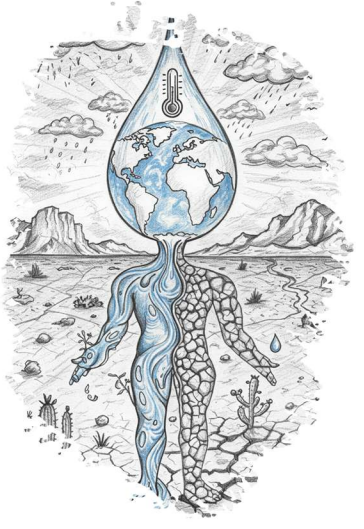


ABSTRACT

This paper examines the use of water management as a tool for enhancing regional stability in arid environments, focusing on the Israeli Negev Desert. With water scarcity being a well-known challenge in the region, the study proposes an approach that integrates innovative technologies, establishing a youth-focused education center, and strengthening community collaborations. We specifically highlight the expansion and replication of successful local initiatives that advance educational work within schools (as seen throughout the research), with the Bedouin communities of the area as a case study. Emphasizing the importance of building bridges between the Bedouin and non-Bedouin communities in the Negev, the research proposes the establishment of a youth-focused education center as a key initiative. The research entails a detailed analysis of the relationship between the unique socio-political dynamics in the area and water scarcity. The research further explores responses that possible interventions would acquire through data collected from surveys and interviews which will assess the needs, desires, and existing conditions of the target audience. The information gathered was crucial to understanding and filling gaps in the existing literature regarding our target audience. The findings suggest that water management can significantly contribute to social and regional stability in the Negev Desert, through which the study aims to provide a model for vulnerable desert communities in the MENA region.



INTRODUCTION



The human body, composed of approximately 60% water, and the earth's surface, covered by 70% water, underscore the elemental bond between humanity and its environment (U.S. Geological Survey, 2019a; U.S. Geological Survey, 2019b).. Efficient water management is critical to maintaining the vital connection between humans and the environment. As climate change becomes a predominant global challenge and water resources become depleted, water scarcity challenges escalate leading to striking figures of four billion people, two-thirds of the global population, experiencing extreme water scarcity at least once a year (UNICEF, n.d.). The issue is exasperated in the arid climates. Deserts, characterized by low precipitation and relative humidity, present unique challenges in water allocation.

Despite the harsh conditions, deserts are home to nearly one billion people who rely on groundwater and brackish water, resources that are increasingly depleting due to climate change and overexploitation and water allocation becomes a testing task (Patel et al., 2023; Callahan et al., 2019; Kong et al., 2011).

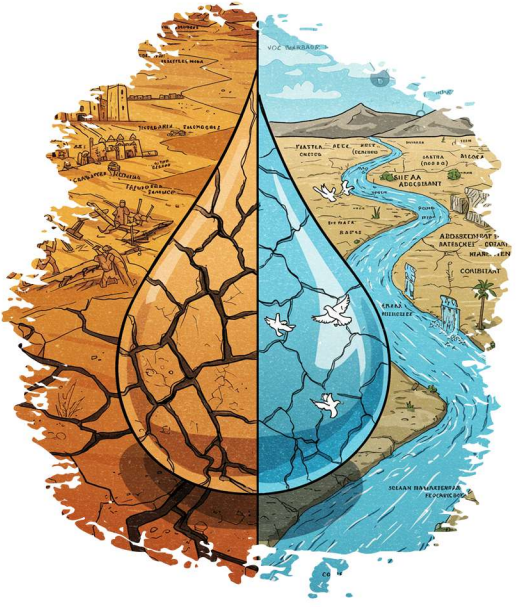
INTRODUCTION

This research will delve into the subject of internal water management, drawing from concepts from water diplomacy, proposing it as a tool with a preventive role for regional stability in arid areas in the MENA Region, focusing on the case of Bedouin communities living in informal villages in the Israeli Negev desert. They are perceived negatively by the non-Bedouin residents of the Negev who live in the surrounding major cities and townships of Jewish majority (Sivan, 2022). Using the guiding research question "how can water management technologies and systems be leveraged to promote coexistence in desert-based vulnerable communities?," this paper aims to provide a multifaceted approach to addressing internal water management and its ramifications on the socio-political fabric in the Negev Desert, and serves as a case study for the broader context of vulnerable desert communities in the MENA region.

INTRODUCTION

The issue of water scarcity deepens environmental challenges while also historically instigating socio-political conflicts. It is suggested that water conflict dates back as early as 2500 BC when two groups clashed over water and irrigation in western Asia (Pacific Institute, n.d.). In the context of the area of interest to the research, the MENA Region, transboundary waters conflict has arisen many times throughout the years, with the Suez Crisis of 1956, the Sharm el Sheikh blockade of 1969, the Red Sea Crisis of 2023-24 being some of the examples. International relations between states and other groups in the MENA region are dependent on water distribution (Said, 1971). This has been the case with the Israeli Arab Diversion Plan of 1964-1967, the conquest (in 1967) and annexation of the Golan Heights by Israel in 1981, the Israeli-Jordanian Peace Treaty of 1994, and the Israeli-Palestinian Peace Process' Oslo II Accord of 1995 (Wolf, 1995).

Transboundary water management is a highly discussed topic with multiple success stories between hostile riparian states that led to the prevention of further conflict and regional stability (Gleick, 1993). However, much less is observed regarding the internal management of shared water resources and its potential as a catalyst for conflict or prosperity and stability.



CASE STUDY: STATUS OF WATER ACCESSIBILITY IN UNRECOGNIZED BEDOUIN COMMUNITIES OF THE NEGEV DESERT

The Bedouins are of Arabic descent, however, they have no defining origin within the Arabic lands due to their historically nomadic lifestyles within the deserts of Arabia (Katsap & Silverman, 2016). Regarding their modern day geographic
locations, Bedouins currently reside in the Middle Eastern deserts of Egypt, Syria, Jordan, Saudi Arabia, United Arab Emirates, Iraq, and Israel (Kark & Frantzman, 2012). Israel's southern half, the Negev Desert, is home to approximately 300,000 Bedouins who live in four varieties of residential establishments: unrecognized
settlements, yet-to-be-recognized settlements, newly recognized villages, and governmental planned townships (Almasi, 2023). The residents of these establishments, especially
unrecognized settlements, face continuous
resource allocation difficulties as a result of
numerous challenges that will be discussed below.

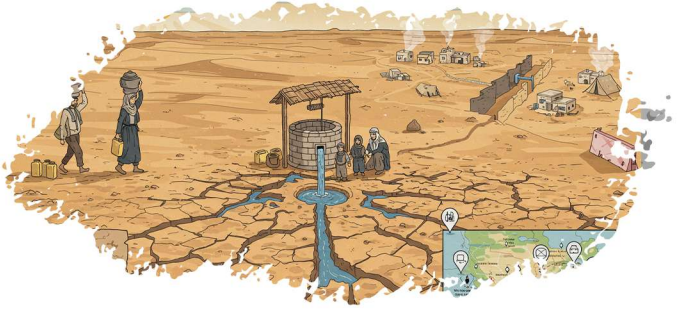
CASE STUDY: STATUS OF WATER ACCESSIBILITY IN UNRECOGNIZED BEDOUIN COMMUNITIES OF THE NEGEV DESERT

The Israeli government has continuously pressed for the unrecognized communities to relocate to recognized Bedouin cities and settlements, where municipal water and other services are more reliable. However, due to cultural territorialism as well as disputed boundaries and land ownership, many believe this to be an unviable solution (Murthy, et al., 2013). Generally, across southern Israeli towns, cities, and industries, Mekorot, the national water courier, provides water year-round (Ministry of Energy and Infrastructure, 2018). However, this is not the case in the Negev's Bedouin communities. Currently, 11 Bedouin settlements in Israel are recognized, while 35 settlements remain unrecognized (Negev Coexistence Forum for Civil Equality, n.d.).

Unrecognized Bedouin villages face challenges in receiving such water services from Mekorot, with 91% of settlements not having water infrastructure at all. This is partially due to their vast dispersal deep within the desert and the disparities between the Bedouin population of the Negev and the Israeli government (State Comptroller, 2021). Consequently, those living in the unrecognized settlements often resort to illegal conduct and actions to obtain water resources. Mekorot Courier incurs about 105 yearly instances of damage, 4 stealth, and harm to national infrastructure and resources in the Negev area due to illegal activities of members from Bedouin communities. 2021 marked a notable 57% water depreciation in the area mainly due to the theft of water by residents of unrecognized villages (also referred to as HaPzura in Hebrew) from the Neve Midbar water corporation. Moreover, there is no existing body responsible for sewage treatment in unrecognized villages (State Comptroller, 2021). Accordingly, the Israeli Negev locals suffer from the situation and tend to distrust the Bedouin population. The growing social rift makes it difficult for partnerships, understanding, and cooperation to flourish (Tamir & Gutovnik, n.d).

In sum, the socio-political and cultural rift among Negev residents, combined with the desert's unique geographic and climate conditions and water distribution challenges make for a volatile environment that is not easily manageable by any of the actors involved. In our view, if left untreated, these tensions could catalyze an irreversible rupture in Israeli society with repercussions on national and natural resource security.

TARGET AUDIENCE



The research is centered on examining the water accessibility conditions within Bedouin communities in Southern Israel. We have chosen to engage with Bedouin individuals residing in this region due to their unique perspectives on the challenges and conditions of water management within their communities. Focusing on Bedouin communities in the South of Israel allows us to hone in on a group facing distinct socio-economic, geographic, and technological challenges, particularly those residing in unrecognized settlements.

TARGET AUDIENCE

We emphasize participation from a broad age range, between 19 and 60, aiming to represent the future leaders of these communities. Their responses are reflective of current conditions as well as indicative of future trends and potential areas for intervention. The lifestyle and settlement patterns of the target audience are integral to this study. This understanding enables the proposal of viable solutions that are effective but also culturally and contextually appropriate. By excluding urban Bedouins and those living in the northern regions of Israel, our study maintains a focused geographical scope that allows for a more detailed and specific analysis of the water existing management issues. This decision is grounded in the recognition that different regions face different challenges, influenced by a variety of socio-economic and environmental factors.

The ultimate goal in selecting this specific audience is to gather comprehensive, firsthand information on water accessibility that reflects the complex interplay of geographical location, cultural practices, and administrative recognition. This is crucial for developing targeted, sustainable solutions that address the challenges Bedouin communities face in Southern Israel that can hopefully serve as a blueprint for other cases of vulnerable communities in the area, especially seeing as Bedouin communities reside in other countries such as Jordan and Egypt. Moreover, this focus underscores the importance of understanding and improving water accessibility is not just about addressing a basic human need, but rather recognizing and respecting the rights, traditions, and needs of the vulnerable community. This research aims to contribute to a body of knowledge that supports the development of informed, effective, and respectful water management strategies, highlighting the critical intersection of human rights, environmental sustainability, and cultural heritage.

WATER DIPLOMACY AS A PATH FORWARD

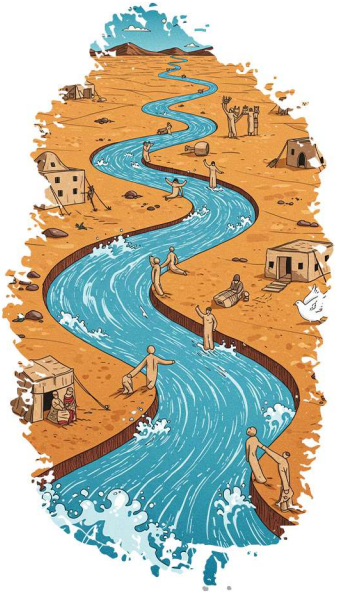
Despite the prevalence of water cooperation agreements on transboundary sources, there is a notable gap in addressing internal water conflicts. By examining the case of the Negev Desert, we explore how addressing internal water scarcity can set the stage for broader regional cooperation, ultimately contributing to stability in the tension-embedded region. Our research into water diplomacy reveals both the challenges and opportunities in fostering cooperation and peace through the strategic management of water resources. By emphasizing conflict prevention, mediation, and governance frameworks that promote transparency and benefit-sharing, we highlight the potential of water diplomacy based initiatives in mitigating regional tensions and fostering long-term stability.

For purposes of our research, we use Schmeier's definition of water diplomacy – "the use of diplomatic instruments to existing or emerging disagreements and conflicts over shared water resources to solve or mitigate those for the sake of cooperation, regional stability, and peace" (Schmeier, 2018). This paper will draw from water diplomacy concepts with the sim of enhancing national security and stability, rather than international stability. In the context of national instability between communities of the Negev desert, both preventative and cooperative aspects of water diplomacy are examined. The preventative concept entails conflict prevention and mediation, as well as building trust and confidence. Cooperative water diplomacy addresses governance frameworks with transparency and benefit-sharing (Keskinen, 2021).

LITERATURE REVIEW

Water holds significant cultural and social value, particularly for Bedouin communities, where it is intricately woven into their daily lives and practices (Aboul-Naga, 2018). The complexity of water management in these contexts is thus multifaceted, encompassing ecological, economic, and cultural dimensions. There is an intricate relationship between water management and diplomacy in the MENA region is an emerging field of study.

As many countries in the region share water sources, efficient and collaborative management strategies have the potential to enhance regional stability and foster peace. According to a UN Water Conference Report from 2023, effective water management practices in transboundary regions have increased cooperation between neighboring nations, contributing to regional stability (United Nations, 2023). This section will examine the lessons learned from different cases and how they can be applied to address the water management challenges that this research's case study presents as well as its applicability in similar groups throughout the region.



DIFFERENT APPROACHES TO SOLVING WATER SCARCITY IN ARID CLIMATES

The following section summarizes several case studies from different regions in the world, where communities dealing with issues of water quality, availability and accessibility have successfully incorporated technological solutions to overcome these challenges.

DIFFERENT APPROACHES TO SOLVING WATER SCARCITY IN ARID CLIMATES

- When managing water for irrigated agriculture in the Central Arizona Desert, USA, the challenges faced by farmers, especially their reliance on irrigation and the impact of climate 6 change, are examined in a study published in a scientific investigation report of the U.S. Geological Survey (Page, W.R. et. al., 2018). Strategies of water allocation in this region include the flexible use of groundwater and surface water sources and stakeholder collaboration (Eakin, 2021) In the Santa Cruz Basin, Arizona, the key strategy shifts to groundwater management, where a three-dimensional geologic model aids in understanding water flow and identifying deep aquifers. This approach is instrumental in informing sustainable groundwater use.
- In Xinjiang, China, research in the Aksu Farmland Ecosystem has been directed towards partitioning evapotranspiration components in cotton fields, using stable isotopes for precision irrigation management in arid areas (Zhao et al., 2023) (these concepts have not been used before, you might want to explain a bit). Similarly, the Tarim Basin in Central Asia presents a study examining the dynamics of groundwater levels affected by the land-cover change, emphasizing the importance of sustainable groundwater management (Wang et al., 2023).
- Research conducted on a runoff simulation and reconstruction using machine learning models in the High-Cold Mountains Area highlights the significance of accurate forecasting in water resource management for arid zones (Wang et al., 2023).
- From West Africa, a study on drought hazard modeling using extreme value theory offers an advanced method for drought hazard assessment (Bonjean, 2023).

DIFFERENT APPROACHES TO SOLVING WATER SCARCITY IN ARID CLIMATES

Incorporating insights from global studies, such as those presented above, can support the development of more efficient water management strategies with desert-based populations. This approach is not about presenting external solutions as definitive but rather about facilitating collaborative knowledge exchange. Integrating local expertise with adaptable water allocation strategies, like those seen in Central Arizona, can help develop comprehensive water management plans. Moreover, the implementation of advanced monitoring and forecasting systems, similar to those in the Xinjiang and High-Cold Mountains studies, could enhance the effectiveness of water distribution and resource management. Such systems can provide real-time data and predictive analytics, aiding in better resource allocation and decision-making. Engaging Bedouin communities in a dialogue that merges their traditional knowledge with other methods of water management could aid in fostering sustainable water use, drawing inspiration from methods employed in the Santa Cruz Basin and West African studies while adopting them to the needs of the Bedouin communities.

DIFFERENT APPROACHES TO SOLVING WATER SCARCITY IN ARID CLIMATES

Additional and insightful case studies range from limiting aquifer over-pumping in the Northwest Sahara Aquifer System to implementing affordable water treatment solutions in Zambia and Kenya (Kinzelbach, et al. 2010; Mabande, 2018). They provide perspectives on sustainable water and sanitation management and
emphasize the importance of community engagement, integrating modern technologies with traditional practices. These technologies not only provide new
avenues for efficient water usage and conservation but also offer tools for predicting and mitigating the impacts of climate change on water resources. Innovation is key to achieving water sustainability in arid regions and beyond. The implementation of technology in this context must take into account the unique characteristics of each environment. Different regions require flexible solutions that can adapt to the specific context and conditions of each case. In the case of the Negev Bedouin communities, alternative water technologies are preferable over conventional innovations. The reason is that conventional technologies are not designed to perform in low relative humidity and they do not
consider these communities' lack of resources. Conventional water innovations presuppose the ability to pay, access to existing infrastructure, extensive energy requirements, and an initial flowing water source (i.e., desalination, recycling wastewater, etc.)(Peeters, et al., 2020). These are resources that vulnerable,

DECENTRALIZED SYSTEMS IN VULNERABLE COMMUNITIES

A decentralized approach would allow such communities to obtain a sustainable water supply without relying on the centralized grid and the infrastructure of the surrounding urban areas (Cherunya et al., 2015).
In his study of Kenya, Cherunya explored water-borne diseases, lack of sanitation, and contaminated drinking water in low-income communities, and discusses how a private entity provides decentralized sustainable and clean options for
drinking and domestic water. Through quantitative and qualitative surveys, this group of researchers found decentralized water solutions to be successful, viable, and long-term options.
An additional study, led by Biorefinery Engineering and Microfluidics (BEAM) Microfluidics Research Group in Pakistan, was conducted to determine if solar-powered decentralized water systems could be installed in a way that preserves the natural environment. Conventional, industrial wastewater and drinking water supply systems often contaminate and pollute water sources (Hafeez, et al., 2021). It concluded that it is viable and less environmentally harmful for wastewater and potable water systems to be replaced with solar-powered decentralized alternatives. (Hafeez, et al., 2021; Lioubimtseva et al., 2004).
As regions around the world continue to experience the challenge of water scarcity and environmental degradation, the results from the BEAM research Group highlight the critical need to employ sustainable water management practices. It becomes imperative to explore innovative solutions that can provide reliable, sustainable water sources to communities that experience such challenges.

AWG TECHNOLOGIES AS A SOLUTION FOR ARID CLIMATES

One promising innovation that has emerged as a viable solution, specifically in arid climate, is Atmospheric Water Generation (AWG). This method suggests an approach to water extraction using the surrounding air. AWG technologies can be employed in ways that apply to our research. Such methods are based on adsorbent materials that perform efficiently in low relative humidity and require little to no initial water flow, energy source, or infrastructure. AWG is the process in which water vapor is captured from the ambient air and can be used for irrigation and further treated to allow for clean, potable water (Peeters, et al., 2020).

AWG TECHNOLOGIES AS A SOLUTION FOR ARID CLIMATES

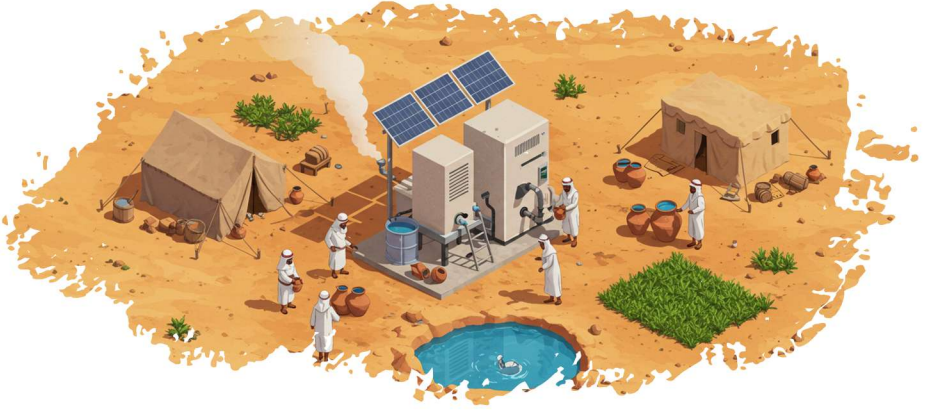
In a study by Hengyi Lu, an AWG device utilizes PAM-LiCl, which can absorb water vapor in conditions of low relative humidity. This material was made using a combination of hygroscopic gel (PAM) and lithium chloride (LiCl). The substance was ground to form a powder-like material and tested under different humidity levels. The results show that the PAM-LiCl combination can manipulate the state of the water molecules within the molecular structure of the gel, making the water molecules very loosely bonded and reducing the heat required to separate such molecules (Lu, et al., 2022). Thus, releasing the water requires very little energy. These researchers' work proves PAM-LiCl's ability to collect and release significant amounts of water under low relative humidity, using little amounts of energy, and provides insight for future application of this substance as a viable material in innovative solutions for water harvesting in arid climates (Lu, et al., 2022).

AWG TECHNOLOGIES AS A SOLUTION FOR ARID CLIMATES

Researchers from the Massachusetts Institute of Technology and the University of California, Berkeley, designed a device that utilizes the process of condensation to harvest water from the air, specifically in arid climates. The device has many components, but its state-of-the-art MOF-801 (metal-organic framework) as an adsorbent for water vapor makes this research exceptional. When relative humidity is higher at night, the MOF-801 layer can adsorb water vapor at humidity levels lower than 40% (Kim, et al., 2018). Along with the use of MOF-801, attached to the device is a solar absorber, which converts sunlight to solar thermal energy. Using the MOF-801 and solar absorber, this device requires few resources outside the patent.

AWG TECHNOLOGIES AS A SOLUTION FOR ARID CLIMATES

AWG technologies can be designed and developed to require little to no previously allocated resources. This type of innovative water technology, developed specifically for arid climates and require little resources, is an example of the type of technology that could be suited for addressing water management challenges in the Bedouin unrecognized villages.



PEACEBUILDING THROUGH JOINT WATER MANAGEMENT

In this section we examine examples of cases in which water diplomacy has been successful in settling disputes or disagreements regarding transboundary water bodies in the MENA region. Insights from transboundary water management can be helpful in the domestic context. For example, the preventive role of water diplomacy in conflict prone regions between hostile riparian states, as observed below in the examples of the Tigris and Euphrate rivers or the cooperative
opportunities established through water diplomacy agreements between Jordan and Israel (Gleick, 1993). These examples show the roadmap to a creative, sustainable and efficient way of mitigating tensions while enhancing cooperation and communication through a shared interest, water resources

PEACEBUILDING THROUGH JOINT WATER MANAGEMENT

Efficient water management strategies in drought and conflict-prone regions that can contribute to enhancing regional stability instead of exacerbating crises (Beaumont, P. 2010). In 1994, a peace treaty was signed between Israel and Jordan. A large portion of the treaty implicated the terms and allocations of both sides regarding their shared transboundary water sources (Beaumont, 2010). The treaty recognizes that resolving the two countries' competition over shared reserves is crucial for setting a precedent for peaceful diplomatic relations between the two states (Beaumont, P. 2010). The success of the treaty played a part in improving Jordan's relationship with the US, which has since committed to providing Jordan with security and military funding (AlMomani, 2012, p.6).

PEACEBUILDING THROUGH JOINT WATER MANAGEMENT

The agreement eased the Israelis' concerns about security on the Jordanian front (AlMomani, 2012, p.6). The mutual commitment to compromise on shared water sources has contributed to a relatively stable relationship between Israel and Jordan. Three decades on, both parties' adherence to the treaty has allowed further collaboration regarding shared water resources such as research and information sharing regarding the Dead Sea and its conservation in 2015 (Aggestam & Sundell, 2016). This tripartite agreement illustrates the opportunities lying in using water as a vector of collaboration rather than one of competition.

PEACEBUILDING THROUGH JOINT WATER MANAGEMENT

Another example is the case of the Tigris and Euphrates rivers and the surrounding water diplomacy tactics, which highlights how crucial proper management of transboundary resources can be to coexistence among the MENA region. The rivers originate in Turkey, and run through Syria and Iraq, creating the Euphrates-Tigris (ET) Basin (Kibaroglu, 2020). These riparian states have continuously worked on developing strategies to properly allocate water for their populations.

PEACEBUILDING THROUGH JOINT WATER MANAGEMENT

Two bilateral protocols have been initiated among the three countries: the Turkish-Syrian Protocol on Economic Cooperation of 1987, and the Syrian-Iraqi Water Protocol of 1990 (Kibaroglu, 2020). These were implemented to set minimum flow requirements for all interested countries and facilitated interim agreements of the shared water source. In addition, several non-governmental actors take roles as 'track-two' diplomacy initiators, as they can see beyond political agendas and take the interests of the three riparian states into account.

PEACEBUILDING THROUGH JOINT WATER MANAGEMENT

The ET basin has seen many track-two diplomacy actors take crucial roles in its water management, such as the Euphrates-Tigris Initiative for Cooperation (ETIC) (Kibaroglu, 2020). The ETIC was established in 2005 and consists of professionals, previous diplomats, technocrats, and scholars from all three riparian states, and works with the Turkish, Syrian, and Iraqi governments to establish cooperative solutions to transboundary water allocation with complete transparency and utmost collaboration efforts, even amidst regional conflict (Kibaroglu, 2020).

PEACEBUILDING THROUGH JOINT WATER MANAGEMENT

While currently there is no basin-wide, all-encompassing political agenda between the three countries, a collaborative institutional framework was intended to spread a nuanced cooperative understanding among the countries to further develop water allocation and diplomatic efforts. The Joint Technical Committee (JTC), while never reaching deployment stages, was envisioned as a way for the ET basin states to foster fair management of the rivers (Kibaroglu, 2020).

PEACEBUILDING THROUGH JOINT WATER MANAGEMENT

While these riparian states have since experienced conflict within their borders as well as disparities among themselves, their implementations of bilateral agreements, non-governmental initiatives, and institutional frameworks highlight how promoting dialogue, shared understanding, and collaborative efforts can set a precedent for future conflict management as well as encourage the regional landscape of stability and coexistence.

PEACEBUILDING THROUGH JOINT WATER MANAGEMENT

The sections above explored the role of water as a potential catalyst of conflict as well as how it can act as a bridge between actors in tense opposition. Innovative water technologies were identified as the most viable and suitable solution for Bedouin communities in the Negev, specifically AWG technologies.
Assessing technologies and past practices and failures enabled us to find suitable solutions capable of advancing water management as a tool for fostering cooperation. Decentralized solutions seem particularly suited for the case under review.

METHODOLOGY

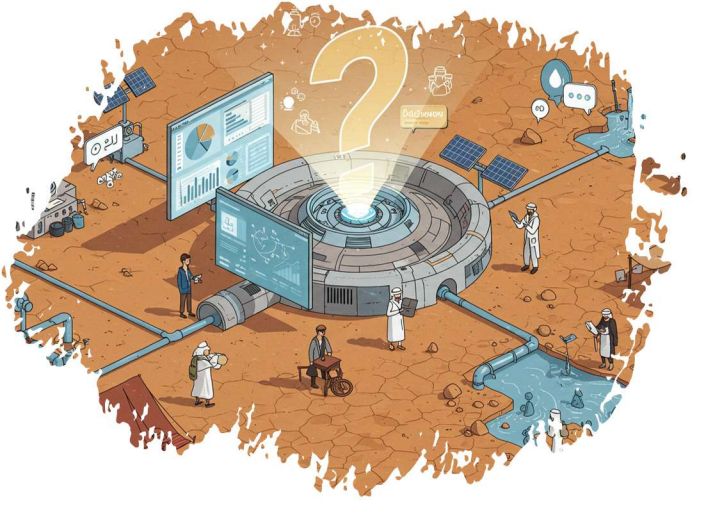
The sections above explored the role of water as a potential catalyst of conflict as well as how it can act as a bridge between actors in tense opposition. Innovative water technologies were identified as the most viable and suitable solution for Bedouin communities in the Negev, specifically AWG technologies. Assessing technologies and past practices and failures enabled us to find suitable solutions capable of advancing water management as a tool for fostering cooperation. Decentralized solutions seem particularly suited for the case under review.

METHODOLOGY

There is a lack of literature addressing the unique circumstances of unrecognized villages of Bedouin communities in the Negev Desert. To bridge this scholarly gap, our team has carried out a series of interviews and long-term dialogue with professionals who dedicate their work to studying and improving intercultural relationships in Southern Israel with a special focus on Bedouin communities.

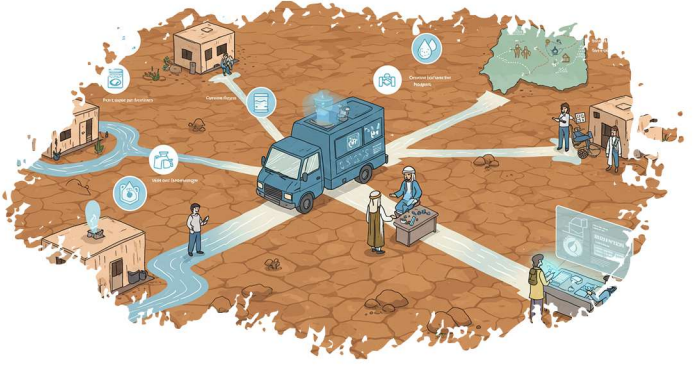
RESEARCH APPROACH

This research paper adopts a mixed-method approach, combining both qualitative and quantitative research methods. This methodological integration is crucial for gaining an understanding of our primary focus, the Bedouin communities in Israel. The identified scholarly gap lies in part in the lack of information available about these communities. Therefore useful information for this research such as data regarding awareness and accessibility to clean water, community interactions, and infrastructure accessibility was to be gathered by the research team so to provide a solid foundation to investigate the guiding research question – "how can water technologies and systems be leveraged to promote tolerance and coexistence in desert-based vulnerable communities?" The following outlines how we went about collecting data and building an analysis which led us to find answers to our question.



PRIMARY METHODS

The primary research focuses on surveying one key area: Bedouin unauthorized and informal settlements. In the Bedouin communities, the survey is designed to deepen our understanding of water use patterns, accessibility, and needs within these communities, and to gauge their openness towards innovative solutions. It also seeks to explore their perspectives on cooperation and coexistence in the Negev area, emphasizing a preventative approach to managing water resources. Complementing the surveys, interviews were conducted with significant local figures and researchers in innovative water technology.



PRIMARY METHODS

This research includes virtual interactions with stakeholders through digital platforms like Zoom, to identify needs and identify appropriate water technologies for arid and vulnerable regions. Additionally, dialogues with experts in decentralized water sources aim to provide a comprehensive overview of the technological viability and practical application of these solutions in community settings. This methodology aims to elucidate the lived experiences of Bedouin settlement residents with water scarcity and explore potential preventative strategies for water management, focusing on the technical, political, and social dimensions to proactively support regional stability.

SECONDARY METHODS

In addition, the literature review aimed to undertake a holistic review of case studies from various regions to conduct a comparative study on the approaches used to address challenges similar to those faced by our target communities. Concurrently, conducting an extensive review of current innovative water technologies tailored for arid climates and how such discrepancies and resolutions have impacted the respective regions. This review has 11 played an important role in helping us understand the technologies' applicability and their potential impact on the communities we are studying.

RESULTS

Survey: Designed to capture the nuanced perspectives of the Bedouin communities in regard to the management and accessibility of water in their living areas, the survey helped identify the needs of the Bedouin communities, and provide us with a better understanding of the specific challenges that the local populations are facing.

RESULTS

Sample Audience Characteristics: The responses were primarily from males (55%) with a notable representation from females (45%). Participants spanned various ages with a significant number of respondents in their 30s and 60s, the majority of which reside in unrecognized villages (45%), with others living in recognized towns or cities (35%) and desert oases (20%).

RESULTS

Perception of Water Issues: There is a significant awareness of water shortage problems in the southern desert regions. Respondents indicate a dire and scarce water, with many noting a lack of connection to a reliable water network, suggesting a substantial number suffer from a lack of water. Some respondents claim to have “extensive knowledge” of the issues, while others claim to feel the impact of water shortages directly, citing high costs and impure water supplies.

RESULTS

Perception of Social Disparities: An overwhelming majority (65%) believe there is discrimination against the Bedouin community. Inequalities in the provision of basic resources are widely recognized (55%), with numerous respondents confirming neglect and a lack of infrastructure. The social status of the Bedouin community is perceived to be negatively impacted by said disparities.

RESULTS

Perception of the Desert as an Active Factor: The desert's role is implicitly acknowledged through the recognition of water scarcity and the associated challenges, such as environmental concerns and demographic pressures. The responses suggest that harsh desert conditions exacerbate the water issues and social disparities faced by the community.

RESULTS

Involvement of Israeli Authorities: A substantial portion of the respondents (45%) indicate that they are not connected to the Mekorot water network, which suggests a limited involvement of Israeli authorities in managing water supply and quality within these communities. The other (65%) chose not to answer.

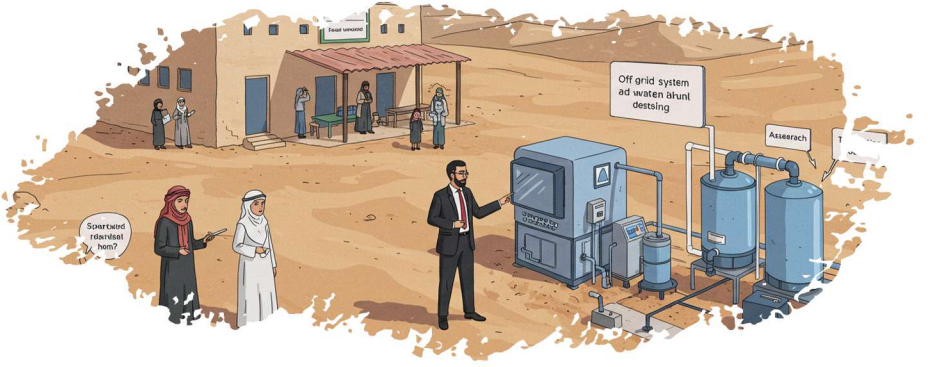
RESULTS

Limitations: The size of the survey results (20 answers) may limit the statistical value of the findings. However, the responses provide valuable insights into the challenges faced by the Bedouin communities concerning water management and social equity, and the barriers of 12 Israeli involvement in such communities. The surveys certainly helped us better understand the challenges faced by the communities and how they perceive centralized water management.

INTERVIEWS

We interviewed two professionals, Farid Mahmid, and Dr. Clive Lipshtein, who works in the Center for Transboundary Water Management in the Arava institute. They are currently developing a groundbreaking project in Bedouin Communities. Located in Bedouin schools, their project aims to provide off-grid water management solutions and to research further developmental potential. The interviews with Dr. Lipshtein and Farid as well as the survey's results shaped our recommendations, which include a youth-focused community center. To further explore this direction, an additional interview was carried out with Dr. Tamir Rotman, a clinical psychologist and founder of the Israeli based Free Spirit Organization, a multicultural therapeutic program for adolescents. Rotman's perspective serves as a representation of multicultural coexistence in a youth setting. We include a summary of the interviews below.

INTERVIEWS



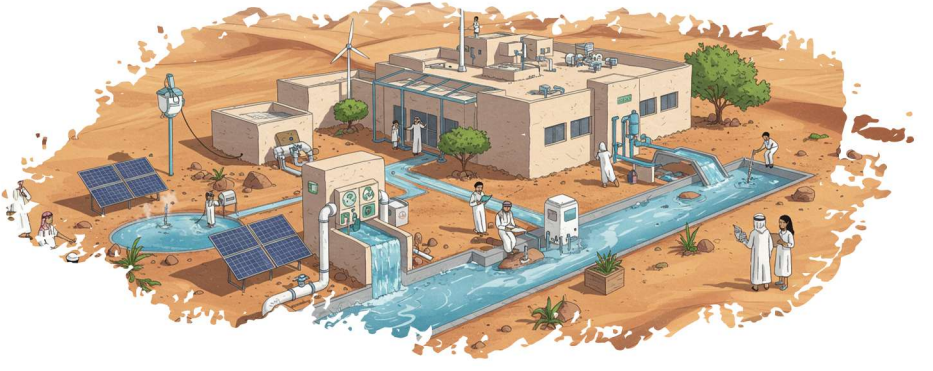
Interview with Farid Mahmid: Farid Mahmid is the assistant director for the Center of Transboundary Water Management at Arava Environmental Institute ("the Center"), helping the director carry out hands-on, research-based projects in Israel. Examples include but are not limited to off-grid wastewater management, off-grid desalination, professional training programs, and conferences, as well as forwarding policies and technologies for transboundary water resources management. Mahmid also manages the off-grid hub inside a school in Al Fora – an unrecognized Bedouin settlement. The team visited the site on February, 15th, 2024 (see Annex A).

INTERVIEWS

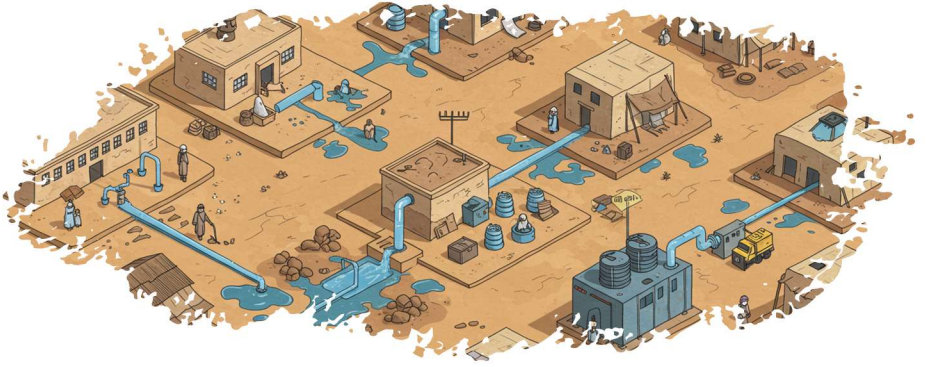
The school hub constitutes a successful attempt at creating an all-encompassing, innovative system for a holistic, integrated, and decentralized off-grid solution to the issues of water and resource allocation in Bedouin settlements such as Al-Fora. The hub is being constructed inside the local school in which 3,000 students from the neighboring settlements study from elementary school to high school. In the hub, all off-grid technologies work together. The system consists of recycling wastewater, water-generating technology (explain, cite), and solar panels, with infrastructure built for a future biogas station to convert organic waste to energy as well as a designated area and plans for a future community garden.

INTERVIEWS

The first goal of the project is for the school to become self-sufficient, based on off-grid technologies, thus requiring no previous infrastructure which has been unreliable and outdated, hindering the school's activities and work. The second goal of the hub is to provide sustainable solutions for the 13 allocation of scarce resources, impacting the natural landscape of the desert to a minimum and most importantly engaging and teaching the students about natural resources, the importance of their conservation, and the operation of the hub. Or as Mahmid states, "I will know when the hub has succeeded when the day I finish my job here ends, I go home, and no one calls me again for help."

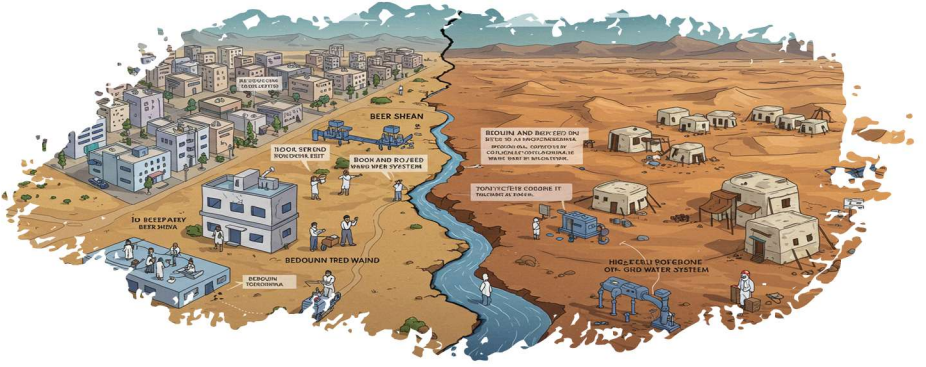


INTERVIEWS



Farid Mahmid made it clear that the concept of accessibility to water in both recognized and unrecognized settlements is not 'one size fits all', each place requires different suited strategies as the current systems for water distribution are unsustainable both for the environment and for long-term management. Some of the unrecognized settlements do however have schools, thanks to the Israeli Supreme Court ruling Hok Hahinuh Hahova requires mandatory education, Mahmid adds. These schools are connected to Mekorot points, however, water pressure is very poor and the water wells are frequently flooded, becoming unsanitary. Most of the schools have diesel generators for electricity and septic tanks for sewage, paying for contractors to remove the wastewater from the septic tanks, which usually incurs high costs.

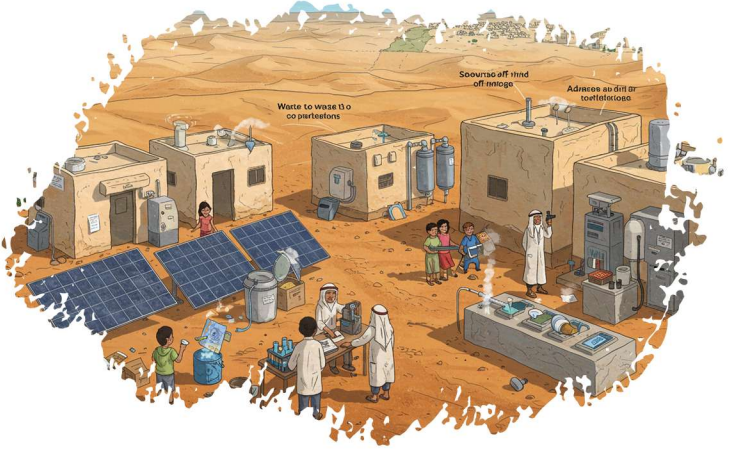
INTERVIEWS



Except for Arad and Al Fora, most of the relations between the communities are very strenuous and tense. There are the satellite towns of Beer Sheva (the major urban center of the South of Israel also referred to by Israelis as the Capital of the Negev)but there is no engagement between the communities outside of the workspace and hospitals. The citizens of these towns perceive their Bedouin neighbors as 'non-taxpayers' who live for free on stolen resources and agriculture on illegal lands. Farid's initiative aims to change the public's perception of Bedouin communities and forward potential collaborations – the technologies implemented in the off-grid hub stem from partnerships with Israeli high-tech companies.

INTERVIEWS

The hub initiative is particularly promising as it builds on cooperation that benefits both sides. It promotes development and a sense of pride in Bedouin settlements; it tests high-tech solutions developed by Israelis in extreme environments. There exists asymmetry in the region, Mahmid describes, in which one side has a surplus of sources, and the other has none. Mahmid and his team are working to provide and suggest ways of thinking outside the box by showing the untapped potential of investing in Bedouin communities through these projects. Mahmid asks rhetorically , "Why are (Israelis) going all the way to Africa? There are places within (Israel) that need the same help!". Mahmid believes that if his team can provide off-grid technologies to these communities, they can succeed in providing themselves with their own basic needs while worldwide climate change affects the livelihood of vulnerable populations, leading to conflicts, immigration, and socio-political changes. Thus climate resilience is not only crucial to the environment but also to local and regional stability.



INTERVIEWS

Interview with Clive Lipshtein: Lipstein is the Director of the Center for Trans-boundary Water Management at the Arava Institute. According to Lipshtein, potential solutions need to meet the Bedouin's cultural needs and should not be based on the solutions that exist for regular Israeli cities, as they are not suited for the Bedouin's ways of living and have consistently failed. In the Bedouin settlements water is not only used for domestic activity but also livestock and agriculture purposes. Lipshtein and his team are exploring ways to provide water for all their 14 different uses. Dr. Lipshtein's objective is to help in a way that the Bedouin communities can be self-sufficient. Like Mahmid, Lipshtein highlights the significance of collaboration: "we have resources they don't have, and they have things we don't." He reiterates that each community's and society's water needs are different as are their ways of conserving it. Dr. Lipshtein emphasizes one of the main discrepancies is the unrecognized Bedouin communities' lack of infrastructure. Like Mahmid, Lipshetin highlights that even though some Bedouin communities may access Mekorot's connection points, this is not a sustainable source of water considering the low pressure so the Bedouin communities must find a way to overcome these issues, which is not always possible.

INTERVIEWS

Lipshtein claims the solution lies in decentralized water systems. The government approach is narrow, viewing the only way to provide water to these communities is to connect them to the national grid, a costly method due to their distance from the local grid connections. Liphstein asks the question, “Why do you insist on saying you'll connect them but you consistently never do?". Decentralized systems can provide solutions within the community itself, which is much more suitable for the circumstances. Dr. Lipshetin and the team would want to see the government support such solutions through funding and regulations instead of paying for the connection to the national grid. Slowly, the government is coming to this realization, that not every community is as accessible and has the same characteristics as 90% of the country in urban settings.

INTERVIEWS

Dr. Rotman insists on the impact of exposure to early practice and information in shaping an individual's beliefs and personality. He explains that prejudice against foreign groups can be a survival function of the brain to identify the group to which a person belongs. As such, the more diverse the exposure to people that are different from an individual at a young age, the more inclusive the sense of 'us' and 'them' is likely to be and vice versa. For example, a pair of species together, ex: a cat and a dog, introduced at a young age become part of each other's inner group, whereas if it were later, they'd view the other as an existential threat as a natural mechanism. Thus, a positive context of exposure to people of diverse backgrounds, looks, and languages expands one's sense of who is a part of their system and inner group. Acknowledging the different people who one is exposed to at a young age enables one to learn to solve problems as part of their inner group, together, which could prove efficient in the societal context. The opposite patterns can lead to the creation of conflictual behavior among the different groups.

INTERVIEWS

Accordingly, in the context of resource allocation, water management can continue being a source for competition and obstacles or become a source for joint cooperation for its sustainable use and conservation, a common goal to address the interests of the different involved parties as partners instead of adversaries.

INTERVIEWS

Any model of joined problem solving, experiential education/therapy, being out in nature and experiencing a model together makes a huge difference. Whether it is crossing a river, transferring water from one place to another, it all creates a process that facilitates coexistence and shared visions. One should understand that there will usually be conflict of opinions and priorities within group dynamics, especially new groups but that's part of learning to work as a group and reaching a common goal which requires group problem solving. An effective method for such facilitators is experiential learning through a Group Process – the practical experience of problem solving rather than theoretical.

INTERVIEWS

The method entails the natural progression of group process in which individuals learn to overcome internal conflicts that arise in the problem solving process allowing for trust and cohesiveness within the group as all participants can feel heard and accepted. Therefore, future collaborations and discussion become more open and receptive with a stronger sense of inclusion. It is important to apply experiential learning in young groups from different backgrounds through problem solving in group processes. The context of water resource allocation challenges provides an ideal frame to apply the practical experiential learning.

CONCLUSIONS

Following our collection of data from the survey and interviews with professionals in the field, our team identified insightful themes regarding the status of regional stability and coexistence in relation to water scarcity in the Negev desert. We reflect on our findings, highlighting areas for development and critiques of current circumstances.

CONCLUSIONS

- Pervasive Water Scarcity and Inadequate Infrastructure – the acute awareness and experience of water shortages among the respondents point to a critical need for improved water infrastructure and access. This is compounded by the absence of connection to the main water network for many, which affects daily life and suggests systemic neglect of the community's basic needs.
- Perceived Discrimination and Social Inequality – the data indicates a strong perception of discrimination against the Bedouin community, particularly in terms of resource allocation and infrastructure development and maintenance. This perception is likely influencing community relations and could be a contributing factor to the existing social tensions.
- Need for Engaged Authority Intervention – the lack of involvement from Israeli authorities, as perceived by respondents due to the disconnection from the
- Mekorot network, highlights a call for a more proactive engagement in addressing water management issues. This suggests an opportunity for authorities to foster trust and improve living conditions by investing in essential services.
- Environmental Awareness and concern – the survey respondents demonstrate environmental awareness of the negative role that the climatic and geographic local conditions have on the issue of water scarcity and water allocation.

CONCLUSIONS

Towards a future of sustainable water solutions and peaceful cooperation The insights gleaned from the results underscore the imperative for comprehensive interventions and research initiatives. The interwinding dynamics of water scarcity, social inequality, environmental awareness and governmental engagement delineate a multifaceted landscape demanding nuanced approaches.

CONCLUSIONS

The respondents' awareness of water shortages and impacts of lacking infrastructure highlights the dire need for improved water access and infrastructure. The necessity is compounded by the systemic neglect of basic needs, evident in the absence of connection to the main water network for many individuals. Addressing this issue requires development of alternative water systems that are suited for the unique situation of the unrecognized settlements, prioritizing community engagement and implementing solutions that stray from the conventional national grid connection, which, as discussed in the sections above, has proved to be inefficient at best and non-existent at worst.

CONCLUSIONS

The pervasive perception of discrimination against the Bedouin communities, particularly with regards to resource allocation and infrastructure development, influences community relations and exacerbates existing social tensions. Hence, initiatives aimed at promoting social equality, inclusion and cohesiveness, fostering inclusive decision-making processes are crucial to achieving sustainable water solutions and peaceful cooperation.

CONCLUSIONS

The lack of management from Israeli authorities, as perceived by respondents due to disconnection from the Mekorot network or the improper service, accentuates the necessity for proactive governmental interference in addressing water management issues. Such interventions would present an opportunity to promote trust between authorities and the Bedouin population while improving living conditions by investing in essential services. It is imperative that public institutions recognize their role in supporting a marginalized community

CONCLUSIONS

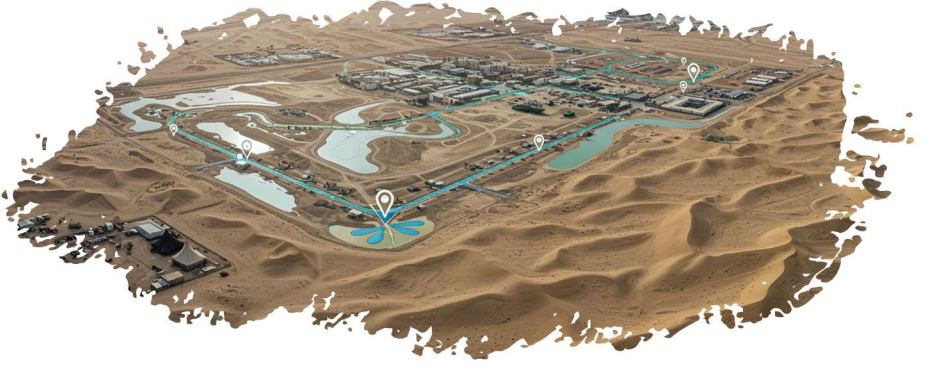
Furthermore, the demonstrated environmental awareness among the survey respondents opens a space for a mutual struggle and concern between the Bedouin and non-Bedouin residents of the Negev, that of environmental and resource conservation. One of the only times in which a rare instance of bicultural cooperation in the Negev, both entities, the Bedouin, and Jewish communities of that particular region in the Negev, joined forces. They decided to ignore their everyday discrepancies, cultural values, and political stances, to legally oppose a project led by Rotem ICL in proximity to several unrecognized settlements such as Al Fora as well as 'formal' southern cities such as Arad and Dimona.

CONCLUSIONS

The dispute, which started as early as 1999, revolves around a phosphate mine that is planned to be constructed in Sde Barir, 3.5km from the city of Arad, 2km from the recognized Bedouin city of Ksseifa, 2.5km from the yet-to-be recognized Bedouin city of Kassif and only 1km from the unrecognized Bedouin settlement of Al-Fora, with Bedouins in scattered holdings living in the planned construction site itself (Spektor, 2013). Since then, a series of contrasting environmental and health risks reports have been carried out by different public and private bodies. While unintended, the potential environmental threat posed by Rotem ICL's planned mine acted as a catalyst for unity, where the urgency to protect the Negev's natural resources outweighs previous differences within the two communities.

CONCLUSIONS

This was also reported by Farid Mahmid. He showed us exactly where the mine would be constructed and highlighted the joint efforts of the otherwise estranged communities for what he called their genuine concern and love for the surrounding natural landscape and resources and their conservation. The complex weave of water management, if leveraged, could be the string stitching together the fabric of coexistence among different cultures and communities.

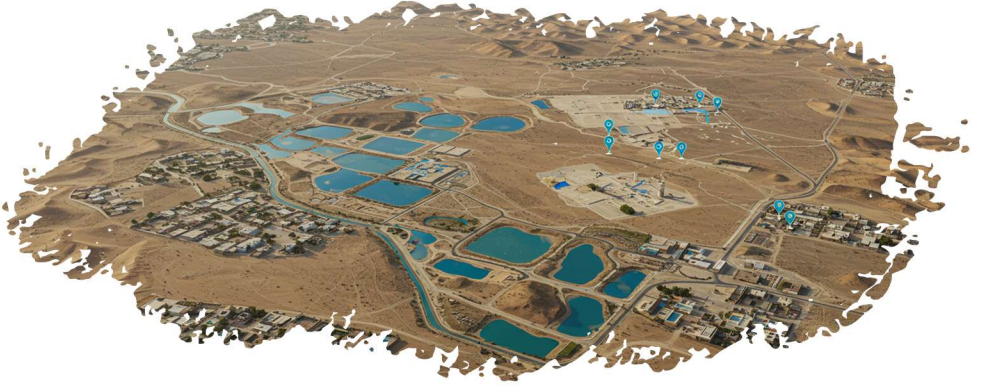


CONCLUSIONS

Regarding environmental conservation, water management would be the common denominator for a shared interest of preservation of natural resources, 17 blurring differences and fostering a shared sense of responsibility and obligation. This merging of values surfaces when a region is faced with potential threats to its environment, where diverse populations become united by a communal concern for their shared natural resources, such as water. It is a model that could certainly be replicated in other circumstances.

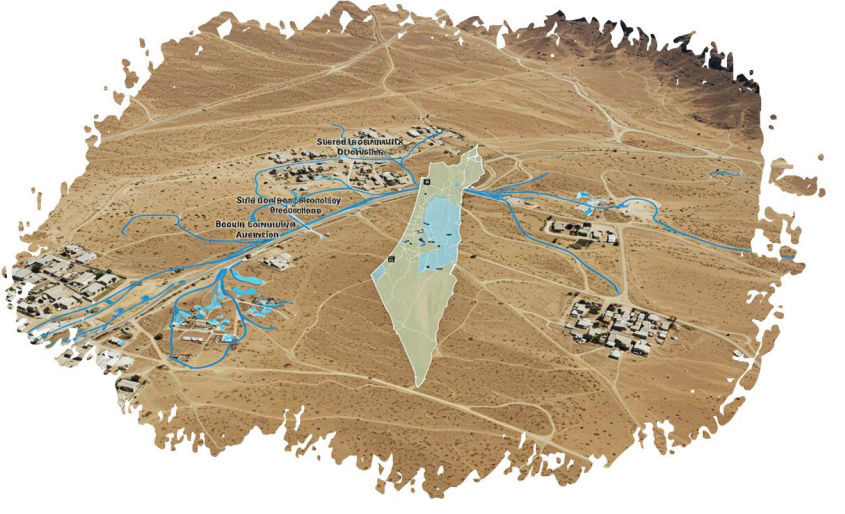
CONCLUSIONS

Natural resource preservation presents an avenue for mitigating tensions and fostering collaborations and stability in the long term. Through collaborative efforts grounded in mutual respect and shared responsibility, coexistence can be strengthened, allowing for sustainable water solutions and peaceful intercommunity partnership.



REFLECTIONS & RECOMMENDATIONS

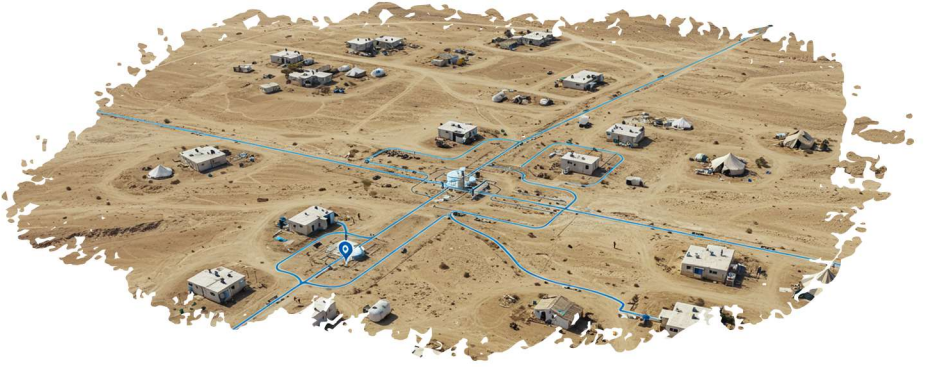
The understanding of the many cross-sectoral points of strain that are embedded in the issue of water management in arid regions makes it possible to adopt a multifaceted and solution-driven approach. We propose three main recommendations. First, we suggest a low scale single alternative to connectivity to the national grid that incorporates the findings from the scholarly literature and Dr. Lipshtein's preference for decentralized methods. Second, for the short-term, we recommend an initial shift in the approach of interactivity between Israeli authorities and Bedouin communities, where track-two actors act as communication pipelines and facilitators to an improved dynamic.



REFLECTIONS & RECOMMENDATIONS

The third recommendation proposes a long-term solution in the form of a project to be carried out in the aftermath of the (successful) implementation of the first two steps. It advocates for the creation of a youth community center in which environmental, societal, political and infrastructure challenges can be addressed, while shaping and enabling the future leaders of the Southern Israeli district, especially in the Negev.

REFLECTIONS & RECOMMENDATIONS

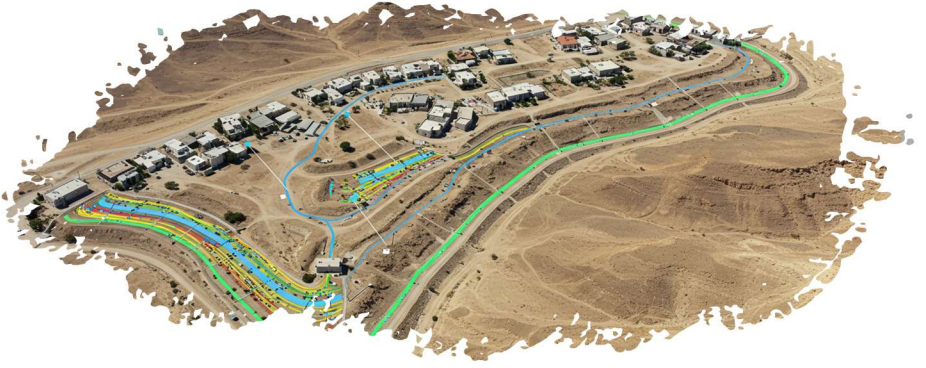


1- Decentralization through Innovative water technology

We recommend the employment of decentralized water systems in places such as unrecognized Bedouin villages in the Negev Desert, where the population lacks connection to the grid of the national water courier, Mekorot.

The independence offered by implementing decentralized systems would further facilitate a sense of empowerment among the Bedouin communities. By localizing water allocation, communities mitigate their reliance on external sources, such as Mekorot and other public entities, which as mentioned by Mahmid and Lipshtein, are subject to the supplier's control and rulings. Furthermore, the actions required to construct, maintain, and utilize these systems offer valuable skills and job opportunities, fostering a sense of stewardship and self-reliance.

REFLECTIONS & RECOMMENDATIONS



Moreover, as mentioned by Mahmid, water allocation systems in these remote villages are not 'one size fits all', thus allowing the potential for specifically tailored systems to be built based on each village's environment, needs, demographic, usage patterns, and resources available. Thus allowing for their exact needs to be met, and further decreasing reliance on external support for aid and supply.

REFLECTIONS & RECOMMENDATIONS

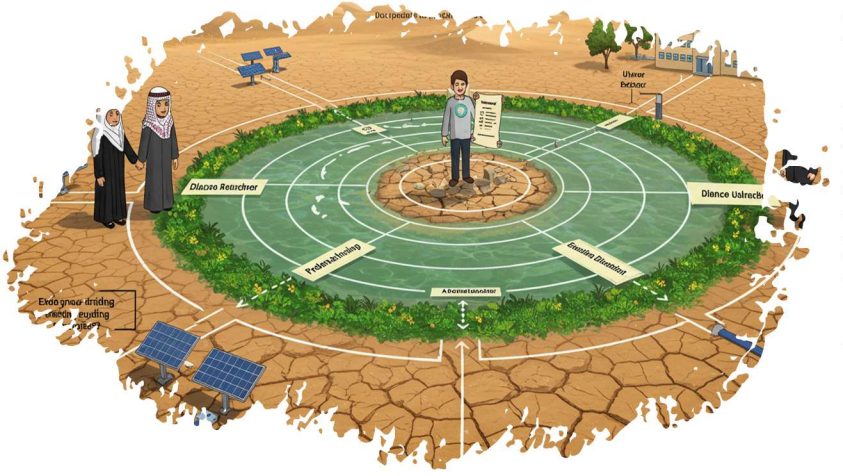
Based on our findings following the examination of the potential benefits of various technologies in vulnerable, desert-based communities, our team has found that decentralizedsystems in these communities would be efficiently implemented through the use of AWG technologies. This includes technologies such as the PAM Li-Cl hygroscopic gel and the AWG method fabricated from MOF-801, two AWG technologies that use minimal resources to extract the mere water vapor from arid air. Efforts include investments in corresponding companies and technologies and professional collaborations between them and off-grid water management initiatives based in the Negev fabricated for unrecognized settlements. A feasible example is Mahmid and Lipshtein's off-grid hub integrating the MOF-801 based technology into the cohesive system they have built in the Al-Fora school.

REFLECTIONS & RECOMMENDATIONS

2- Track-Two mediation for communication paths

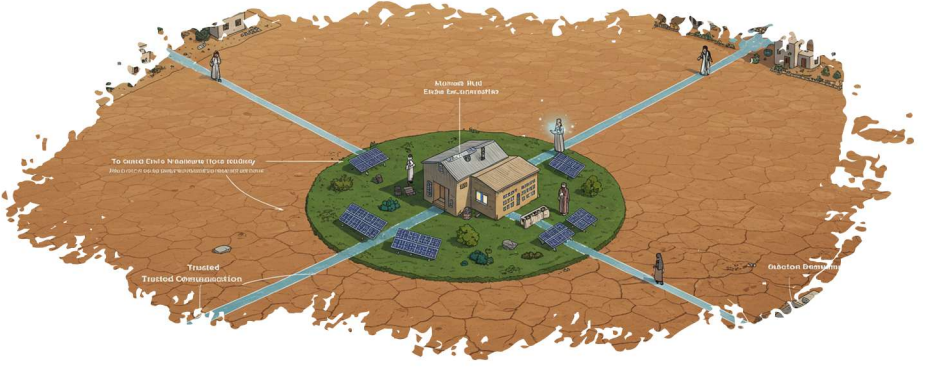
Drawing from Kibraglu's insights on track-two diplomatic actors' roles concerning transboundary water diplomacy, we recommend the employment of similar principles to facilitate cooperative efforts in the local context. Thus, the implementation of track-two diplomatic water management establishments is recommended as an initiative to enhance regional stability and coexistence. The current dialogue and lack of political recognition between the Bedouin communities in unrecognized villages in the Negev and Israeli authorities has proven unsuccessful, as observed in the survey's results. Two-track diplomacy establishments would act as facilitators between the two parties to approach the continuous challenges regarding water allocation and accessibility. This strategy employs both preventative and cooperative roles of water diplomacy, which entail building trust and confidence, as well as political frameworks with transparency.

REFLECTIONS & RECOMMENDATIONS



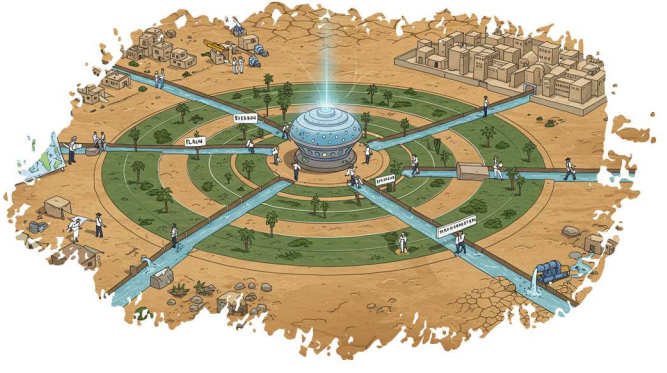
The execution of this concept would be through the utilization of existing infrastructure and actors that have proven successful in providing a space for dialogue and establishment of cooperative initiatives. An ideal prospect for track-two actors would be Mr. Mahmid, due to his familiarity and previous work with both conflicting parties, his fluency in both Arabic and Hebrew, and the current success seen in the project he is carrying out in the Bedouin school in Al-Fora. Mr. Mahmid is not a member of neither the Bedouin communities nor the Israeli authorities and would be able to serve as a neutral figure.

REFLECTIONS & RECOMMENDATIONS



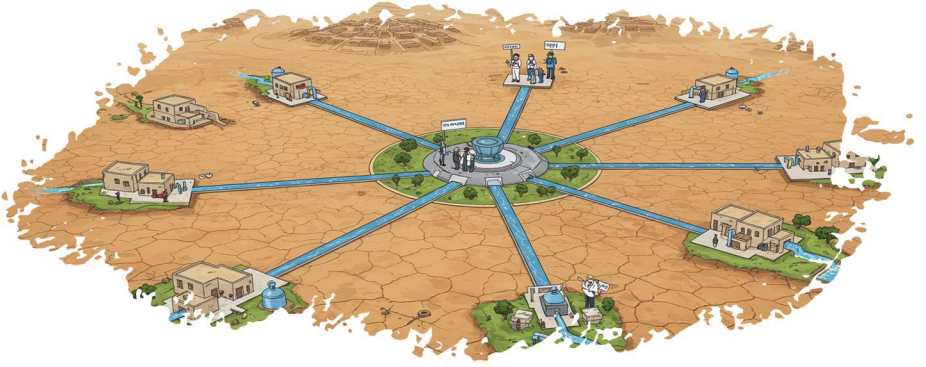
Mahmid's off-grid hub in the school provides the resources to both approach and collaborate with the Israeli government, and to act as a representative and trusted figure among Bedouin unrecognized settlements. We see the identification of additional significant figures with the potential of implementing track-two diplomacy as crucial for the creation of a successful and effective dialogue between the parties, as other attempts have failed or have rarely been implemented.

REFLECTIONS & RECOMMENDATIONS



The responsibility of the track-two figures would involve bringing current discrepancies in the unrecognized communities to the attention of policymakers, including but not limited to, water accessibility and recognition of settlements. They would also discuss and suggest potential suitable decentralized water management techniques as well as other solutions fitted to the needs of specific villages. Moreover, this facilitates a platform for the involved Israeli officials to communicate relevant messages and changes. This is especially important as reaching out to Bedouins residing in the unrecognized villages has been a problematic task, hardly accomplished by Israeli authorities.

REFLECTIONS & RECOMMENDATIONS



Additionally, the role would provide an opportunity to broaden the narrow scope of possible solutions applied by the Israeli government thus far. These track-two entities would be endorsed by the Israeli government, and trusted among both the Bedouin and non-Bedouin 19 communities of the Negev. The past solutions have relied on the assumption that solutions should involve public infrastructure and providers (ie, Mekorot's water connection points), which has proven economically and physically unfeasible and ineffective due to the dispersion of the Bedouin unrecognized villages in the desert. The many issues stemming from these circumstances have been discussed throughout the paper. This highlights the need for a shift in approaches, to one based on dynamics of dialogue, representation, and cooperative relationships between Bedouin villages and the Israeli government to achieve long-lasting, sustainable and suitable solutions.

REFLECTIONS & RECOMMENDATIONS

3- Streams of Coexistence Youth Community Center

Lastly, we recommend the establishment of a water management-focused community center for Israeli and Beduin youth, named 'Streams of Coexistence Community Center.' The goal of this establishment is to encompass all learnings from this research and construct a central body to do so. The aim of the community center is to disrupt the intergenerational, unstable relationship between the Jewish and Bedouin populations of the Negev, teach younger generations about water management, and give communities who reside in arid climates and/or vulnerable settings the resources to bring awareness and solutions to their residential environments.

REFLECTIONS & RECOMMENDATIONS

By teaching groups about water conservation, management, technologies, and systems at a young age, this initiative will foster a more sustainable mindset for the future in these communities. In the last century, the concepts of waste, exploitation, and disregard to the ecosystem were fueled by economic growth and political agendas, resulting in outlooks among the world which have since caused significant damage to our environment (Reid, 2019). The next generation of leaders are thus responsible for reversing this damage and preventing further harm. To prepare, the current frontrunners must incorporate a shift in mentality, to one in which the younger populations acknowledge their impact on the environment and their responsibility to the planet.

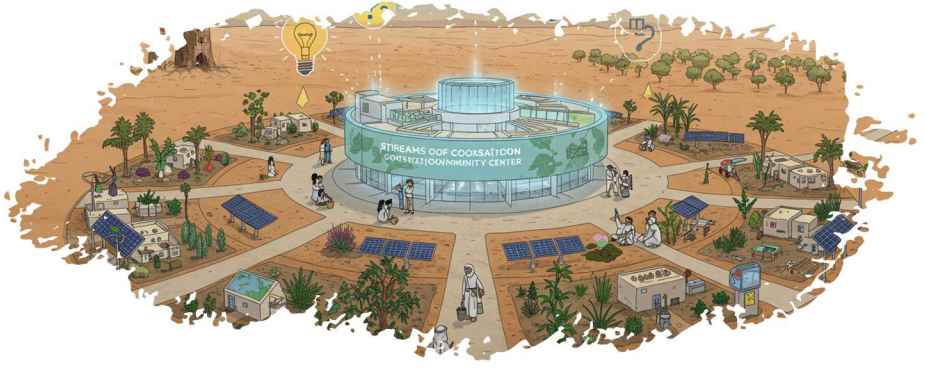
REFLECTIONS & RECOMMENDATIONS

This paradigm shift starts small: community education. The Streams for Coexistence Community Center will foster such a shift, bringing awareness to environmental initiatives, sustainable lifestyles, and preventive measures of further harm. In addition to a paradigm shift, environmental education among children urges them to question their actions and to critically ponder the systems surrounding them. Children will learn to explore conflict from various angles and to cultivate opinions and solutions. Such critical thinking is fundamental for developing a more sustainable world (Lloyd Center for the Environment, 2023).

REFLECTIONS & RECOMMENDATIONS

As seen throughout this study, the hostile social barrier that separates the Bedouin communities' potential of innovation and the surrounding communities' access to resources is characterized by generational prejudice and societal stereotypes. Drawing from Dr. Rotman's insights on multicultural learning environments, early-on exposure to diverse groups will broaden participants' 'inner-circle,' resulting in a wider concept of inclusivity and narrowing the gap between them and people who earlier generations considered existential threats. By constructing a bicultural environment for youth and future leaders, participants are encouraged to facilitate the conflict resolution stage of a group process, thus further embedding a sense of trust and codependency among the group.

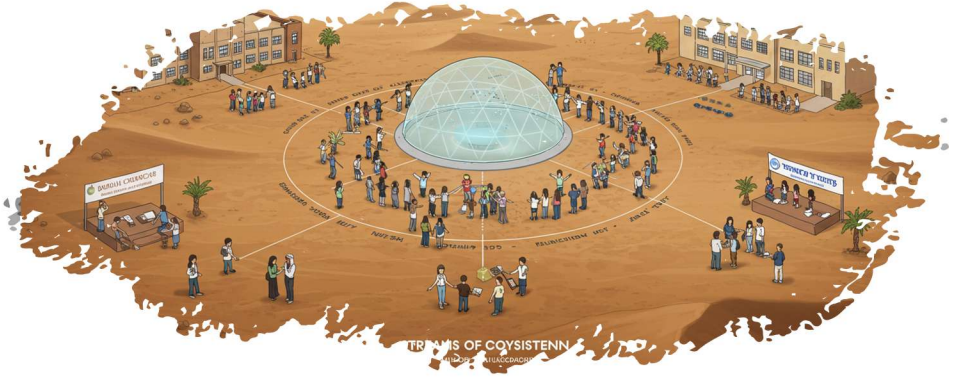
REFLECTIONS & RECOMMENDATIONS



Through the The Streams for Coexistence Community Center, the fantasy of a cohesive society in the Negev in which coexistence is encouraged and celebrated will gradually become reality, by fostering a cohesive, collaborative environment between Bedouin and non-Bedouin participants. We strive that the two groups will feel empowered in a joint notion, giving them the feeling that they must rely on each other for assistance and participation in order to reach a common goal.

REFLECTIONS & RECOMMENDATIONS

With regards to logistics, this recommended community center is suggested to be established in a setting where neither populations feel superiority over the other. The ideal system would be utilizing schools of both communities to host the center's many events/activities, switching off between host-schools, allowing each to feel equally valued. This should be a safe space, where children attend lessons, workshops, and bonding activities in which they feel welcomed, respected, and valued.



REFLECTIONS & RECOMMENDATIONS

The leaders of the programs held in this center can vary from different positions, including but not limited to: university students of environmental sciences, sustainability, and/or development, professionals from the field of water management, environmental engineering, environmental sciences, etc., and teachers with specializations in appropriate subjects. Training must be required for all contributing entities, including multicultural education, basic environmental training, and anti-bullying and inclusivity training. Further funding and grant proposals are required for investment, execution, and establishment of this community center.

REFLECTIONS & RECOMMENDATIONS

Our recommendations provide a mixed method solution for the challenges faced by unrecognized Bedouin communities in Israel, which can hopefully provide a blueprint for a similar approach in other Bedouin or desert-based vulnerable communities facing resource allocation and access disparities in the MENA region. By fostering an approach based on collaborative cooperation, where community members are encouraged to become engaged in the management of these systems and decision-making processes, we expect a change in the dynamics of residents from Bedouin unrecognized settlements, Israeli authorities and other residents of the Negev desert to improve significantly. Ultimately, the sum of these steps enable a scenario of better national stability and security and encourage the development of sustainable relationships and water accessibility across the region.