ABSTRACT

Title of Thesis:	TAKING ROOT: Balancing Socotra's Sustainable Development Through Agro-Tourism
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Post-pandemic tourism has surged, leading to over-tourism, where popular destinations are experiencing social, economic, and infrastructural displacements. This resistance, as well as the desire for more meaningful travel, has shifted tourists' desired destinations to those that offer unique cultural experiences and natural beauty, such as the relatively underexplored Socotra, Yemen. While this shift in tourism benefits developing destinations that rely on tourism for their economic generation, like Socotra, it also poses a risk to their social and natural habitats. Unregulated tourism growth in developing regions like the Middle East and North Africa (MENA) threatens natural resources, culture, and local communities. Socotra, Yemen, faces these challenges as its tourism interest grows, particularly due to its designation as a UNESCO World Heritage Site and its endemic biodiversity. A balanced approach is necessary to ensure the island's sustainable development, addressing both pre-tourism efforts, such as enhancing Socotran hospitality skills, and post-tourism strategies, like preserving its natural conservation

zones. Additionally, Socotra's development model has the potential to set a global standard for sustainable tourism, not only for its provided solutions towards tourism's current wicked problems but also for its transitional desert climate's potential to incorporate climate-responsive design, ethical material sourcing, and thermal comfort strategies within its architectural design. This framework can develop a measurable system in which developing nations in similar cultural and natural climates can balance their tourism benefits with ecological, economic, and social sustainability, in a replicable design that can be modified depending on each nation's programmatic demand.

TAKING ROOT: Balancing Socotra's Sustainable Development Through Agro-Tourism

by

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Thesis submitted to the Faculty of the Graduate School of the
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Preface

Through the investigation of equitable eco-tourist strategies within Socotra, Yemen, as a Yemeni-American, I aim to merge my two cultural and educational backgrounds into a holistic cultural and knowledge exchange. This is reflected in the architectural design solution presented, in the hopes of bridging the gap between my two rich backgrounds.

Dedication

I dedicate this thesis to my family, for their unwavering love and support throughout the pursuit of my education, as well as my personal life. They have helped shape the person I am today, and who I aim to be, and I am forever grateful for all the sacrifices they have made to provide me with the opportunity to achieve my goals.

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I would also like to offer a special thanks to my professional advisors, Amy Upton, Paul Bradshaw, Billy Arias, and Antonio Rebelo, who never failed to build upon and develop my architectural language and construction. A big thanks is also due to my academic advisor, Professor Robert Lucci, who helped refine my positionality in approaching this thesis' development.

Finally, I want to thank my friends and studio-mates for always being there when I needed moral support and inspiration to continue my thesis studies.

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List of Abbreviations

1. MENA: Middle Eastern and North African
2. UNESCO: United Nations Educational, Scientific and Cultural Organization
3. EPA: Socotran Environmental Protection Agency
4. DBT: Dragon Blood Tree

Chapter 1: Introduction

Following the pandemic, tourism has surged, leading to the phenomenon of overtourism. This occurs when the influx of tourists overwhelms a destination's capacity, causing social, economic, or infrastructural displacement for locals. In cities like Barcelona, Spain, residents have protested against the overwhelming number of visitors, as the demand for greater infrastructure far exceeds the city's ability to provide it. This call from established tourism cities is driving tourists to seek out more unique, less crowded, and destinations that offer cultural experiences or rare natural scenery. While this shift may benefit some developing nations with low populations that rely on tourism for economic growth, it also poses risks to those same underdeveloped communities. Without careful planning, the sudden surge of tourism to such locations could overwhelm these areas, leading to unsustainable development and harm to local communities and ecosystems.

As tourism trends shift towards lesser-known locations, the Middle Eastern and North African (MENA) region is seeing an increase in tourist interest, and marketing for these destinations has intensified. This surge, particularly in regions that have not previously experienced such high volumes of tourists, can quickly become problematic if there are no effective tourism strategies in place. Unregulated tourism can lead to uncontrolled development, putting pressure on natural resources and disregarding sustainable practices in construction and infrastructure. Additionally, social barriers between locals and visitors can become more

pronounced as tourism increases, creating tensions that could disrupt the social fabric of these regions.

One reason for the rapid, often unsustainable development in these areas is the influx of investment that prioritizes quick returns for luxurious outcomes over long-term sustainability. The demand for comfortable accommodation in remote areas marketed as tourist destinations is understandable, but this often leads to hasty construction that overlooks the region's environmental and cultural needs. A more thoughtful, climate-responsive approach to development is essential, particularly in the MENA region, where hot and arid climates present unique challenges. This raises the question: How can the application of sustainable architecture in hot and arid climates set an international model for ecotourism in developing nations that autonomously promotes natural, economic, and social ecologies?

Socotra, Yemen, is an example of such destinations that are facing this challenge. It is located along shipping and cruise line routes connecting Eastern Asia to Africa and Europe. Due to the island's biodiversity, with 37% of its plant species and 90% of its reptiles being endemic, the island was declared a UNESCO World Heritage Site. Its unique flora and fauna, particularly the iconic Dragon Blood Trees, have made Socotra a sought-after destination for both tourists and natural researchers. Fortunately, the island's remoteness and strict conservation efforts have protected it from the political instability on Yemen's mainland, but increased international interest in tourism threatens to disrupt its natural and social balance.

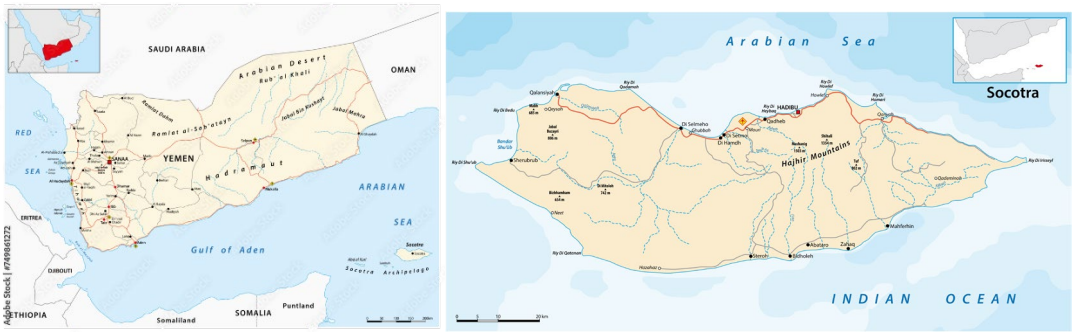

Fig 1.1- Maps of Yemen and Socotra, Yemen.
Source: lesniewski. *Adobe Stock Images*.

The development of Socotra is expected to grow, especially as tourism development begins construction within the island. However, preserving Socotran autonomy while safeguarding the island's biodiversity is crucial to ensuring sustainable development. This requires a balanced approach that promotes tourism while protecting both the natural environment and the social structures of the island's community. By addressing both pre-tourism efforts, such as increasing local proficiency in hospitality services, and post-tourism mitigative strategies, such as creating natural conservation areas, Socotra can develop a tourism model that benefits both locals and visitors.

A comprehensive program that accounts for both approaches for Socotra could incorporate educational and research development initiatives targeted towards preserving its natural habitats, community-oriented programs that host meaningful interactions between locals and tourists, and infrastructural improvements that address the island's limited facilities. These elements could be implemented on a large-scale approach through separate facilities, or on a smaller scale by integrating multiple programs into a single facility. Regardless of the size of the programmatic solution, all forms of development should incorporate sustainable design strategies within their built forms. These implementations can manifest in various ways,

including the ethical and local sourcing of materials, robust thermal comfort strategies suited to the hot and arid climate, and innovative building envelopes that offer both the green incentive sought after by tourists of developed nations, and the sustainable incorporation necessary to accommodate traditional labor implications.

Incorporating sustainable design into Socotra's tourism development would not only protect its environment but also provide a model for other developing nations facing similar challenges. This approach allows for a quantifiable measure of success, as sustainable strategies can be evaluated for their effectiveness in improving local ecologies, economies, and social interactions. By focusing on hot and arid climates, this model could serve as a standard for other regions of similar climates looking to balance the economic benefits of tourism with the need to preserve their natural and cultural heritage. The ultimate goal is to develop a new typology of tourism infrastructure that integrates ecological, social, and economic sustainability, setting a global standard for responsible tourism in developing nations.

Chapter 2: Literature Review

The following literature review will synthesize the general ideas and topics being discussed throughout the architectural thesis and thesis question. Each subtopic was informed based on Socotra's available literature, which the majority of, contrary to what can be assumed based on Yemen's scarce media coverage, was published in recent years with abundant natural and social investigations. However, the majority of such publications were limited to the island's nature and potential tourism development, without much documentation on its geopolitical realm. Therefore, beyond what is necessary for general context, this literature review and architectural thesis will be limited to providing a general overview of Socotra's internal and external views on its biodiversity, Socotra's' social studies, and its outlook on the concept of tourism, and the island's overall conservation efforts and reflections, and how all of these concepts can better inform the design thesis' goals and realization.

Introduction

Socotra, with its multitude of romantic descriptors, encompassed in Shihab's description of Socotra as the "*Arab World's Garden of Eden,"* is a unique island that has captivated the interest of world discoverers, cartographers, natural researchers, and current adventurous travelers alike. Its unique natural beauty and rare biodiversity have inspired a deep, and most times poetic appreciation among those who experience it first-hand. As the conservation biologist Kay Van Damme, who has

studied Socotra's biodiversity for two decades, stated in his interview with Shihab: "I brought my parents to Socotra to see what has stolen my heart – they understood"[1].

The island of Socotra, approximately 1400 square miles in area, is part of the larger Socotran archipelago, with smaller islands located along its Southwestern coastal terrain. Those islands are Abd Al-Kuri (48 square miles, 65 mi Southwest of Socotra), Samha (14 square miles, 30 mi Southwest of Socotra), and Darsa (3 square miles, 25 mi Southwest of Socotra).[2] These smaller islands are minorly inhabited, but Socotra is home to the archipelago's largest population, with some settlers located in and Abd Al-Khuri. This thesis will explore the architectural and developmental possibilities of the main island of Socotra.

Socotra has had its considerable share of influential trade patterns, given the island's position framed 215 miles South of Yemen, 150 mi West of the Horn of Africa, and found in the junction between the Arabian Sea and the Red Sea. Its port has been used by merchants originating from many trade routes connecting Eastern and Southern Asia to the Arabian Peninsula and the Mediterranean.[3] Not only was the island used as a docking point throughout trade routes around 500 B.C., but Socotra was widely known as a hub for its aloe, medicinal sap, frankincense, myrrh, and more, all of which were extracted from its Socotran plants, non-existent anywhere beyond the island. This intersection of ancient trade patterns is supported by a set of

[1] Jamal, Shihab. "Treading Carefully: Saving Frankincense Trees in Yemen," 862–63.
[2] Google Earth Pro. "12.4634° N, 53.8237° E."
[3] Dalal, Kurush. "Socotra Island: A Haven for Ancient Indian Seafarers."

archeological evidence found throughout the archipelago that describes Socotra's inhabitants and settlers.[4]

Many world explorers and cartographers have significantly recalled Socotra in their travels and maps, and the mention of the island's peculiar natural landscape and harsh weather conditions were recurring themes in such records. The first evidence-based world map, for instance, the "Map of the World," created around 1450 by the venetian cartographer Fra Mauro, who used around 3000 descriptive texts like Marco Polo's voyages around the world to document the island.[5] Socotra's size in Mauro's map is significantly large compared to the Arabian peninsula, which is linked to explorers' references' significant claims of this island. An inscription is detailed next to it, and it reads:

> *"The Island of Sochotra, placed between the Sea of Persia and Aden, but more towards the Red Sea and located against the opening of said sea. The inhabitants are generally Christians, and they are necromancers; through their art they deny or sell sailors favorable winds."*[6]

[4] Ibid.
[5] Museu Galileo. "Fra Mauro's World Map."
[6] Ibid.

Fig. 2.1 – Fra Mauro's Map of the World – Socotra Archepilagio.
Source: Museu Galileo. "Fra Mauro's World Map."

The inscription, along with Socotra's visual iconography of the island's most notable trees, The Dragon Blood Tree, is evident of the island's strong natural connections. However, the visualized fortress left of the Dragon Blood Tree, located at the island's port development and Socotra's current capital town of Hadiboh, could be a fortress developed by some of the many settlers that attempted to dominate the island throughout its history. Such settlements and migrant groups have ranged from Ancient Egyptian, Indian, Arabian, Greek, Roman, and Portuguese descent. Through the majority of Socotra's history, the Maharah Sultanate reigned the island along its indigenous group officials. However, beyond Arabian influence, the most notable archeological evidence leads to the island's Indian, Greek, and Portuguese settlements.

In Hoq Cave, located Southeast of Socotra's limestone plateaus, various inscribed entablatures date back to 2nd Century BCE and earlier, with some tablets containing Sanskrit symbols marking a shrine for "Socotri Mata," a presumed goddess of Socotra. Scholars believe that Indian merchants would dock their ships at Hoq Cave's nearest shores and trek through the island's white sand dunes to reach her shrine.[7] Greek Settlements, although unclear in their time period, are also evident in the network of water collection walls that line the entirety of the main island of the Socotra's archipelago. These walls are also believed to be markers of Greek villages and developments; however the architectural evidence is still unclear.[8]

[7] Dalal, Kurush. "Socotra Island: A Haven for Ancient Indian Seafarers."
[8] Rensburg, Julian & Hopper, Kristen. (2017). "Incense and imagery: mapping agricultural and water management systems on the island of Socotra, Yemen." 129-138.

Fig. 2.3 – Sanskrit Inscription in Hoq Cave Archeological Evidence.
Source: WikiBharat. "Hoq cave in Socotra, Yemen."

The most referenced settlement, however, is the Portuguese settlers in 1507. In addition to their inability to adapt to Socotra's harsh monsoon climate, the Portuguese are referenced to have also faced great opposition by the Maharah Sultanate, and were eventually fought out of the island by 1511. The Portuguese established some developments throughout Socotra, one most notable being a fortress, but all developments were demolished by the Maharah Sultanate of Qishn after their reclamation of Socotra.[9] There were no significant changes in social power on the island until the British colonization of what used to be regarded as the Kingdom of Yemen.

[9] Steinbeck, Julie. "The History and Colonization of Socotra," *GreenProphet.* 2024.

The British colonization of the Southern regions of Yemen's kingdom occurred in 1839. The British and Maharah Sultanate of Qishn and Socotra withstood a lengthy, tension-filled process to use Socotra as a militarization point for the British empire, and a treaty was signed in 1876 to exclusively allow British forces on Socotra. A decade later, the British declared Socotra as a protectorate, allegedly for British interest in exploring its botanical assets further.[10] While the British ruled Southern Yemen through the late-1800s to mid-1900s, North Yemen was also driving away Ottoman influence that lasted from the early 1800 to the early 1900s. In 1918, the North of Yemen gained independence from the Ottoman Empire and was renamed as the Republic of Yemen. British rule was also driven away from the southern regions of Yemen in 1967, and was later named South Yemen, with Socotra being encompassed as part of the newly established region. In 1990, the northern and southern regions were then unified to form the Republic of Yemen that is commonly known as Yemen today.[11] Throughout the entirety of these colonial impacts on Yemen as a whole, Socotra itself was faced with great militarization by different fronts and ruling empires, but was also heavily regarded as a botanical point of interest by British natural researchers and their likes throughout the British empire. From early records dating back to the late 1800s, prevalent British and Scottish botanists would visit Socotra to take record of and study the island's rich endemic species for their frankincense, myrrh, and medicinal sap.[12] This botanical effort was

[10] Ibid.
[11] Ibid.
[12] Miller, Anthony G., et. Al. *Flora of the Arabian Peninsula and Socotra.*

consistent throughout Socotra's 1900s history, with publications increasing around the 1960's.

This multitude of research is what eventually lead to the establishment of Socotra's Environmental official authorities, which allowed the island to adopt an official Conservation Zoning Plan in 2000 to protect its natural resources from degradation due to unregulated development.[13] To further the conservation of Socotra, multiple official authorities applied to list Socotra as a UNESCO World Heritage Site, which was achieved in 2008.[14] This marked a great governmental milestone to adopt the official conservation of Socotra beyond greater influences, to preserve not only its nature but its cultural heritage. Environmental efforts were underway after the island's listing as a UNESCO World Heritage Site, however, the Arab Spring's wave over Yemen's mainland would lead Socotra to acknowledge its greater issues: Socotrans' social autonomy.

At the time of Yemen's mainland's protests, Socotra's officials and poets, along with Yemenis on the mainland, protested for the need for governmental reform, while simultaneously advocating for their own regional autonomy. This movement, thoroughly documented by Nathalie Peutz, who first-handedly witnessed their gathering, highlighted the islanders' desire for inclusion in political advancement, and their official recognition as a governmental entity, beyond the umbrella of Hadhramaut's Governorate. Eventually, as tensions escalated and dulled in Yemen's early 2010s, Socotra officially established its own governmental position in 2013: the

[13] The Republic of Yemen: Environmental Protection Council. "Conservation Zoning Plan of Socotra Islands (Socotra, Samha, Darsa, Abd Al Kuri, and associated small islands rocks and rock outcrops).""
[14] UNESCO. "Examination of nomination of natural, mixed and cultural properties to the World Heritage List - Socotra Archipelago (YEMEN)."

Socotran Governorate[15]. Despite this progress in Socotra's autonomy as an acting member of Yemen's government, following years still proved challenging for the stability of Socotra.[16]

In March of 2015, Yemen was faced with major civil and international conflicts that are still ongoing. This was a mere two years after the establishment of the Socotran governorate, and the island faced further instability in November of 2015. Two cyclones, Chapala and Megh, swept through Socotra's land and caused widespread destruction to both its natural environment and built infrastructure. The cyclones severely damaged homes, schools, mosques, and other essential buildings. Given the cyclones' occurrence mere months after severe conflicts began in the mainland, Yemen's resources were too restricted to implement significant aid to the island.[17] This, in turn, led to international involvement in Socotra recovery efforts. Various global entities provided aid as part of post-disaster reconstruction projects. While these efforts were crucial in helping the island recover, they were also cited to have increased international influence on the island's governance, which fueled Socotran protests. This influence, placed Socotra's progress in political autonomy back to being governed by other external entities without Socotrans' holistic representation[18].

This faltering self-governance continues to be a significant challenge for Socotrans and their land, as Yemen's political crisis and international involvement have also led to Socotra's nature and biodiversity becoming subject to external

[15] Peutz, Nathalie. *Islands of Heritage: Conservation and Transformation in Yemen.*
[16] Nagi, Ahmed. "Photo Essay: Socotra, Out of One Cyclone and Into Another."
[17] Ibid.
[18] Ibid.

influences from multiple international actors. The intervention of new global development on the island has not only developed essential buildings in the aftermath of the 2015 cyclones, but it has also introduced greater marketing and building plans to develop the island for incoming tourism. Although beneficial to the economic sustenance of the island, such developments are not in coordination with the locals at which developments are taking hold, nor are natural assets being strictly preserved. This has the potential to create lasting negative impacts on the island's future, especially given that such plans are being developed at unprecedented rates for Socotra's infrastructure and authoritative policy. Therefore, plans for tourism development must be implemented in socially and naturally sustainable methods to prevent any misrepresentation, and to allow for the contribution of local businesses and practice, in order to achieve Socotrans' acceptance. By accurately representing Socotra's autonomy as an island with its set of regulatory natural and social policies, and actively involving Socotrans in the decision-making processes, such tourism development can create a collective incentive that would promote the responsible growth of the island and the enrichment and conservation of its nature. Therefore, this thesis explores the adequate approach to developing sustainable tourism in Socotra while maintaining its cultural, natural, and economic autonomy, and how such development can be used as a model for regions in similar social and climatic conditions. It is synthesized in the following question: **How can the application of sustainable architecture in Socotra, Yemen, set a model for ecotourism that preserves ecosystems, meets user needs, & promotes local autonomy?**

This will be a proposal to advance the current practices adopted by Socotra's tourism industry: eco-tourism. Although this term has many preconceived notions in various literature, the following will further explain this thesis' position and goals related to eco-tourism. Before the topic of eco-tourism design can be explained, a variety of topics must be evaluated through the lens of Socotra and its locals. The overall thesis that explores how the island's built environment can be set as a model *for* Eco-tourism *for the enhancement of developing nations'* ecologies *in desert climates needs to build on the meanings behind phrases that have become assumptive in the building and sustainable industries.*

Model

In this thesis, the word *model* itself is actively being explored, and its meaning can evolve throughout this research. Generally, it is intended to define the scope of the project that can be applied to projects or teachings beyond this specific thesis design and approach. It can manifest in tangible forms, such as a building application, or it could begin to inform intangible social exploration, such as the introduction of local-tourist interaction in humble communities. On a smaller scale, it could become a detailed wall section, only applicable to specific site conditions and materials beyond that of Socotra's. On a larger scale, it could manifest as a phased-out, policy-driven urban strategy that can be widely implemented throughout desert climate regions.

Ecosystems

Natural, economic, and social ecosystems will be explored throughout this thesis to highlight the true and present relationships between the island's natural assets and its

people. There will be instances in which the types of term ecosystem will encompass all of its forms, such as how local Socotran communities consider their natural assets as part of their cultural heritage, and use said cultural heritage to validate their consumption of their natural landscape for economic benefit. Although not explicitly stated, the study of these various ecosystems and relationships can potentially be organized into a standard ethnographic approach to create an understanding of ecosystems beyond Socotra, and instead could be applied to other locations, furthering the topic of the *model*.

Eco-tourism

The Merriam-Webster dictionary defines *Eco-Tourism* as "the practice of touring natural habitats in a manner meant to minimize ecological impact." This thesis expands on the official definition to provide its design guidelines for eco-tourist projects, in no particular order of significance:

1. Strict avoidance of building on land that can be used for native plant species' rejuvenation,
2. Conducting local community meetings (or alternative methods) that inform the design for eco-tourist developments based on local needs, wants, and aspirations,
3. Designing tourism programs that prevent tourists from overstepping local tradition of the land; and,
4. Designing programs that encourage yet mediate tourist-local interaction, based on locals' input,

5. Regulating (if not preventing) tourist interaction with nature and local communities beyond the scope of the development

Socotra's Tourism

Despite Yemen's turbulent political landscape in the mainland, Socotra remains a relative political haven for tourists, largely due to its relatively disconnected administrative governance from the mainland. This is mostly due to international intervention, including UNESCO's conservation efforts to the island for political conflict separation, that has allowed tourism to continue. While other global entities' involvement has kept Socotra out of direct political conflict, new tourism development of the island has treaded bypassing full integration of the locals' autonomy. Additionally, UNESCO has claimed that some tourist development have raised significant concerns regarding the island's natural conservation, due to the planned developments' encroachment onto significant natural zones[19]. The disconnected devlopment from current social needs of Socotrans' can create a desparate gap between locals and visitors, which can lead towards further authoritative instability, which can lead back to the term coined by Battilani: "Heritage Dissoncance." The true meaning of the term created by the island's development without the true integration of its past and present political and state history alongside Yemen's mainland, which can then pull Socotra into conflicting cultural matters that prevent significant cultural and ecological enrichment[20].

[19] Elie, S.D. *State-Community Relations: Political History Conjunctures. In: A Post-Exotic Anthropology of Soqotra.*
[20] Battilani, Patrizia, et. al. "How to Cope with Dissonant Heritage: A Way towards Sustainable Tourism Development," 1417–36

Furthermore, although this international aid has benefited Socotra's economic value, proceeding with Socotra's development by bypassing Yemen and the island's local communities would increase tensions and disconnect locals from the new tourism benefits. Therefore, a sustainable tourism development model is urgently needed—one that respects both Yemeni authority and the autonomy of Socotra's people. This model is currently seen as the typical tourism strategy for Socotra, despite some facilities needing to be upgraded for standard tourism quality. As noted in the Bradt guide, Socotra's tourism experience is already full of potential for natural travelers[21]. Without sustainable intervention and orderly planning, there is a risk of unsustainable growth that could damage the island's local and natural outcomes. This approach would ensure that economic growth is balanced with cultural preservation, while fostering an alliance between local communities, the Yemeni state, and international partners.

Tourism in Socotra is already growing steadily, despite the logistical delays visitors must account for prior to their visit. Currently, tourists can only obtain a visa through one of the island's designated travel agencies, which may be contacted via email, phone, or their in-person locations in Yemen's mainland or Other neighboring countries outside of Yemen's conflicted areas. Given Yemen's political climate, this process is kept fairly basic and involves a simple tourist evaluation, but it remains somewhat vague and dependent on the travel agency responsible for the evaluation. Well-known agencies, such as Socotra Eco-Tours, Welcome to Socotra, and Socotra Adventure Tours, handle the bulk of these applications and flight reservations, and

[21] Bradt, Hilary, and Janice Booth. *Socotra: The Bradt Travel Guide*.

while most flights prior to 2011 were exclusively domesticated through Yemen mainland's international airports, international visitors can now also connect to Socotra from other countries, such as Egypt or the Gulf. In addition to procuring a visa and flight, tourists must also time their visits carefully throughout the year, avoiding the windy monsoon season that occurs around May-September, which can cause significant destruction to Socotra's built and natural environment. The rainy monsoon season of November-March, though it might be challenging, is more manageable for visitors.[22]

Regarding tourist activities within the island, The Bradt travel guide notes that once in Socotra, the most control visitors have over their experience is in selecting the tour agency, as these agencies dictate the itineraries throughout tourists' stay. Tourists can book private tours, join groups, or travel with strangers, but independent exploration is not an option.[23] While this structure helps ensure safety for both the tourists and locals, it raises important questions about the standardization of such travel agencies, given their full control over tourism on Socotra. Most tour guides are native to the island, which increases their credibility in guiding visitors. However, the tour routes and information is less standard, and more dependent on the tour guides' individual experience and knowledge. Additionally, although most guides are equipped with local practices regarding natural and cultural knowledge, some information is difficult to deliver to tourist given some language or traditional barriers. As tourism grows, it is crucial to examine these topics to ensure they remain

[22] *Socotra Eco-Tours.*
[23] Bradt, Hilary, and Janice Booth. *Socotra: The Bradt Travel Guide*.

transparent, fair, and supportive of both the island's heritage and the Socotran communities they interact with.

As stated previously, tourists visiting Socotra follow itineraries exclusively coordinated by tour guides affiliated with few but credible Socotra travel agencies. In addition to providing safe travel sequences, this system is also designed to manage the flow of visitors and prevent overcrowding or overconsumption of the island's popular natural locations.[24] However, despite the critical role they play in controlling visitor access and movement across the island, the tour guides often lack the formal training that is standard for all trips. Additionally, the limited number of tour agencies helps maintain crowd control, but there are concerns about the effectiveness of this approach, particularly when it comes to engaging locals meaningfully in the tourism economy.

The typical tourist journey begins at the island's airport, where visitors are then directed to Socotra's governorate capital city of Hadiboh, where most of Socotra's hotels and restaurants are located. From there, tourists process through a series of camping and driving trips throughout the island, visiting key sites such as the Homhil Hills, Delisha Beach, Hoq Cave, and Arher Dunes, as well as encountering Socotra's unique plant and animal life. Tourist activities include swimming, exploring caves, boat rides, and other nature-based events.[25] However, interactions with locals are often minimal, confined to Socotran tour guides accompanying the tourists. Interactions with women, in particular, are rare, due to Socotran culture and tradition,

[24] Ibid.
[25] *Socotra Eco-Tours.*

but which also creates limited engagement between tourists and the local community. Without more intentional interaction, there is a risk that the locals may begin to view international visitors, particularly those from more developed nations, as outsiders, reinforcing an "us vs. them" mentality. More meaningful exchanges between tourists and locals could develop mutual understanding between the two entities, and activities that promote shared benefits could aid this divide.

Additionally, Socotra's accommodations and infrastructure are basic, reflecting the island's commitment to sustainable, low-impact development. However, this underdevelopment also drives demand for more infrastructure, which can potentially lead to the overdevelopment of the land. For example, most of the island's roads are unpaved sand tracks, and developed utilities such as electricity and running water are limited to major cities like Hadiboh and some villages. Outside of these urban centers, tourists rely on mobile or composting restrooms while camping. While some hotels are in Hadiboh, most visitors camp around the island, as they prefer the natural destinations beyond the city. The only eco-lodge outside of the city is located near Delisha Beach, Delisha Eco-Camp, which offers a low-impact, environmentally friendly structure built from simple local materials.[26] While its social and food service is highly regarded among visitors, the lodge itself is highly exposed to the elements and can potentially be redesigned to offer greater comfort for its users.[27] Though this low-impact development prevents damage from impervious surfaces and other environmental impacts, it also poses challenges for further tourism on the

[26] Bradt, Hilary, and Janice Booth. *Socotra: The Bradt Travel Guide*.
[27] Tripadvisor. "Delisha Beach."

island. Many tourists, even those with an eco-friendly mindset, prefer accommodations that provide a balance between sustainability and comfort, with semi-permanent structures that are both environmentally friendly and protective against the harsh climate. The introduction of more durable eco-lodges, modeled after the Delisha eco-lodge but slightly more permanent and developed, could provide a solution that balances the environmental needs without laying opportunities for impactful designs. Such lodges could offer users comfort without sacrificing their sustainability, helping prevent the overall overdevelopment of Socotra while accommodating its tourists' needs. As tourism continues to grow, finding this balance will be key to preserving Socotra's unique environment and local culture.

Socotra's tourism development is widely acknowledged as inevitable by most contributors to its literature, given the island's growing popularity. However, its relatively blank canvas status presents a unique opportunity to shape its new development using sustainable strategies. According to Slak Valek, "[Socotra] stands at a crossroad: to support development of a mass tourism with negative impacts on the heritage, or to promote truly sustainable forms of tourism".[28] However, she also finds in her study that Socotra's tourism consistently faces language barriers and shortcomings in its tourism facility. Therefore, such basic areas need to be addressed through policy-driven implementation in order to further the overall tourism experience, not only for tourists' enjoyment, but also for locals' participation. Azan has also conducted evaluative ethnographic surveys of multiple stakeholders in

[28] Slak Valek, Nataša, et. al. "Potential for Tourism in Emerging Destinations: Case of Socotra Island."

Socotra's eco-tourist approach, including the qualitative inputs of visitors and locals that indicate a shared agreement that more infrastructural development and local-tourist connections are welcomed on the island. Both locals and tourists also show great interest in protecting Socotra's unique environment and heritage.[29] There have even been instances where natural researchers require the exportation of plant species in order to conduct their research.[30] To bridge the gap, there are multiple plans underway for developing the island, with various international entities involved, it is clear that development cannot be ignored or delayed much longer. However, the challenge lies in managing this development effectively.

Development on Socotra is already underway, although much of it is not yet publicly disclosed. This makes it crucial to act quickly to ensure that future projects follow a sustainable path. These projects are part of a broader trend in the MENA region, where tourism is a key economic driver.[31] However, this growth must be managed in a socially, economically, and environmentally sustainable manner, ensuring that local communities are positively impacted and that the island's rare habitats are preserved.[32] The first step in this implementation process is securing approvals for development, which Socotra seems to be in a good position to accept, as long as such development follows the island's established conservation plans. The next phase involves logistical planning of sustainable development through policy,

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[29] Azan, Layal, et. al. "A Multi-Stakeholder Approach for Ecotourism and Heritage Conservation in Socotra Island," 355–68.
[30] TRACKS - Travel Documentaries. "Yemen's Extraordinary Lost-World Island | Socotra: Island of Dragon's Blood."
[31] Kladou, Stella, et. al. *Tourism Planning and Development in the Middle East.*
[32] *Tourism at World Heritage Sites, Challenges and Opportunities: International Tourism Seminar : ÇEşMse (Izmir), Turkey.*

which, again, Socotra has seemed to be well-established to receive. The current challenge is the design development that integrates established sustainable systems into Socotra's built environment, ensuring that tourism benefits the island's economy without compromising its ecologies.

If Socotra begins with sustainable development, it could become a model for responsible tourism, conversely, if it disregards preliminary sustainable design, it risks the degradation of both its natural and social ecologies, an outcome that could be difficult to reverse. Additionally, it is essential that any development that incorporates sustainable methods prioritizes the environment and local community. The people of Socotra, who have a deep connection to the land, and will be closely involved in tourism, must not feel marginalized or excluded from the process.[33] To avoid this, development must focus on improving local communities by addressing poverty, job creation, education, and gender equality.[34] These steps are crucial to ensure that Socotra's growth is not only environmentally sustainable but also socially and economically beneficial for its people. Also, incorporating local needs into the design and implementation of tourism design is essential for maintaining a sense of autonomy among Socotra's residents.[35] By involving them in conservation strategies and providing them with the resources and skills to develop their own land, a shared incentive approach can be achieved.

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[33] Gravari-Barbas, Maria, et. Al. *Tourism and gentrification in contemporary metropolises : International perspectives.*

[34] Puig-Cabrera, M., et. Al. "Tourism towards the well-being of Small Island Developing States: Tourism Agenda 2030."

[35] *Tourism at World Heritage Sites, Challenges and Opportunities: International Tourism Seminar : ÇEşMse (Izmir), Turkey.*

Socotra's Biodiversity

Socotra's plant biodiversity has had a significant historical past with professionals in natural research, which was a significant factor in the island's designation as a UNESCO World Heritage Site. The island is home to many unique species of trees, flowers, and ferns found nowhere else on Earth. This biodiversity, especially considering its additional wildlife, has drawn researchers from around the globe to sample Socotra's plants and study its wildlife. For instance, Dr. Tony Miller from the Royal Botanical Garden in Edinburgh had visited Socotra for several years to document newly discovered plant species, bringing samples back to Edinburgh's botanical research laboratories in a protected manner for further study.[36] Miller also largely contributed to Socotra's plant records through his thorough publication in 1996. Miller is not alone in this research pattern. Since the late 1900s, researchers from Britain, Switzerland, Norway, and other countries have been involved in research on the island, often transporting plant specimens to their own developed countries' research facilities.[37] This long history of scientific study has not only advanced global knowledge of the island's unique ecosystems, but also helped lay the groundwork for Socotra receiving of its UNESCO status.[38] The recognition by UNESCO of its biodiversity's value has further heightened international interest, including from tourists, further exposing the world to Socotra's assets. This recognition has also helped Socotra in shaping its growing identity as an important ecological and tourist destination.

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[36] TRACKS - Travel Documentaries. "Yemen's Extraordinary Lost-World Island | Socotra: Island of Dragon's Blood."
[37] Miller, Anthony G., et. Al. *Flora of the Arabian Peninsula and Socotra.*
[38] Peutz, Nathalie. *Islands of Heritage: Conservation and Transformation in Yemen.*

The particular interest of Socotra's plants stems from their endemic status and unique structural makeup. The island hosts an array of endemic species, with approximately 1/3rd of its plants exclusively living on its land. The island's biodiversity thrives despite the island's transitional desert climate, creating a unique ecological oasis. Among its most iconic plants is the dragon blood tree, known in Arabic as the "brothers' blood tree," referring to the myth of Cain and Abel, in which the tree was believed to have shaded Abel's grave. The Dragon Blood tree, with its distinctive shape created by its thick branches and dense leaves, plays a crucial role in the overall ecosystem of Socotra, serving as a "nurse plant" species by providing shelter and moisture for other plants and animals. Other significant endemic plants include the cucumber tree, the Boswellia (or Frankincense Tree), and the desert rose, all of which contribute to the island's ecological significance'.[39] [40] Additionally, Socotra hosts a large variety of reptiles, including various geckos and lizards, of which 90% are endemic, further highlighting the island's biodiversity. In addition to reptiles, the island hosts several endemic bird species, such as the Socotran Sunbird, Socotran Warbler, and others, which play a significant role in pollinating plants and spreading seeds.[41] These species, along with prevalent insects like bees, work together to sustain Socotra's delicate ecosystem. However, of all these species, the dragon blood tree stands out for its ecological importance, not only due to its striking appearance but also for its role in supporting the overall health of the island's ecosystem.

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[39] Miller, Anthony G., et. Al. *Flora of the Arabian Peninsula and Socotra.*

[40] Attorre, Fabio, et. al. "Developing Conservation Strategies for Endemic Tree Species When Faced with Time and Data Constraints: Boswellia Spp. On Socotra (Yemen)," 1483–99.

[41] *All About Birds.* "Searching for The Endemic Birds of Socotra Island, Yemen."

The dragon blood tree, Socotra's most iconic tree, holds both economic and ecological significance on the island and to Socotrans. It is deeply embedded in Socotra's culture and biodiversity, and is generally known for its canopy, which is consistently referred to as an umbrella, and its medicinal blood-red sap. The tree's unique structure is key to its role as a "nurse plant" within the island's ecosystem. Unlike typical tree structures, the Dragon Blood, along with other bulbous plants in Socotra and other desert climates, do not host rigid trunk systems that convey annual age rings. Instead, the tree's trunk and branches are internally spongy, to maximize their water retention, while its leaves are dense with high surface area, to capture moisture and help reduce water loss.[42] The tree's broad canopy provides shade for smaller plants growing beneath it, allowing them to thrive in Socotra's harsh, arid climate.[43] These qualities make the Dragon Blood tree essential not only for the plants within its ecosystem but also for the local Socotrans, which uses its sap for medicine and its dry wood scraps as fuelwood. However, the Dragon Blood tree faces a significant threat to its survival. Its population is projected to decline due to its internal complications with regeneration and inconsistent growth patterns. As Habrova states, the tree's population is not facing direct extinction, and instead merely lacks adequate regeneration techniques due to the aging population of existing specimens that lack any reproductive seeds, but still remain alive.[44] Additionally, harsh climate conditions, livestock grazing, and overconsumption of its resources by

[42] Bauerová, Lucie, et. al. "Age Estimation of Dracaena cinnabari Balf. f. on Socotra Island: A Direct Method to Determine Its Lifespan," 840.
[43] Rezende, Marcelo, et. al. "Identifying Suitable Restoration and Conservation Areas for Dracaena Cinnabari Balf. F. In Socotra, Yemen," 1276.
[44] Habrova, Hana, et. al. "Dragon's Blood Tree – Threatened by Overmaturity, Not by Extinction: Dynamics of a Dracaena Cinnabari Woodland in the Mountains of Soqotra," 772–78.

locals and tourists have further contributed to its vulnerability.[45] Despite the Dragon Blood Tree's many uses, from medicinal applications to economic benefits, the tree is aging at an unsustainable rate, risking future population deterioration.

While some efforts have been made to conserve the dragon blood tree, many conservation strategies are impractical due to the island's challenging geography. According to Attorre, the tree's regeneration-potential locations are a large player in its overall decline, as the tree only occupied 5% of its potential habitat in 2007, and only 2 out of 9 areas of the tree's distribution are suitable for the species' refugia, due to climate change and sloping hills.[46]

This calls for a more tailored approach to conservation, one that fits Socotra's unique environment and the needs of its distinct species. Establishing dedicated research facilities and nurseries on the island is crucial to promoting the growth of the Socotra trees and understanding their optimal conditions. Though some nurseries for the Dragon Blood Tree do exist, they are often located near Hadiboh or other cities, which are not located in areas that host effective growth research or resource accessibility. Additionally, the low educational levels among workers in these nurseries further complicate conservation efforts. To protect the dragon blood tree and ensure its survival for future generations, more comprehensive, research-driven conservation strategies must be implemented, especially those that integrate Socotran knowledge, education, and sustainable use of the island's valuable species.

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[45] Miller, Anthony G., et. Al. *Flora of the Arabian Peninsula and Socotra.*

[46] Attorre, Fabio, et. al. "Will Dragonblood Survive the next Period of Climate Change? Current and Future Potential Distribution of *Dracaena Cinnabari* (Socotra, Yemen)," 430–39.

Overall, the trees of Socotra offer valuable lessons through their internal makeup for designing structures that can withstand arid, hot climates. Just as termite mounds inspired architect Mick Pearce to develop an efficient passive cooling system in the Zimbabwean Eastgate Centre[47], similar studies could be conducted on the dragon blood tree to understand its water retention and cooling mechanisms that could inform a unique Socotran design. The island's trees are naturally adapted to Socotra's harsh environment, and such structures can be implemented or adapted to fit a sustainable, circulating built strategy that could inform a built development's infrastructure and interiors. Passive design strategies such as natural shading, ventilation, and water collection could be complemented by low-impact materials and technologies to further improve the interior comfort of structures. Incorporating these biological solutions could help create buildings that are more resilient to Socotra's climate while maintaining a sustainable and low-impact footprint. Furthermore, by studying these natural adaptations to Socotra's environment, designers at various locations and countries could incorporate similar strategies into sustainable building designs dedicated to their location. Integrating natural principles into architecture can ensure that future developments within the hot and arid region can be integrated with the environment while enhancing the quality of life for both their residents and tourists.

[47] Asknature. "Passively Cooled Building Inspired by Termite Mounds — Innovation — AskNature."

Socotra's Conservation

As Socotra stands on the verge of development, it is crucial to balance this growth with efforts to conserve both its natural and social environments, and further implement its conservation plans. According to Slak Valek's statement regarding Socotra's readiness for development, and her emphasis on implementing sustainable strategies, the choice of enhancing growth lies in Socotra's decision, but its future depends on how it navigates this path.[48] As noted by Scholte, Socotra has already begun laying the groundwork for conservation, establishing strategies, and working with the Socotran Environmental Protection Authority (EPA) to better the development of its infrastructure and built environment.[49] However, the Arab Spring of 2011, which occurred after Socotra's UNESCO listing, shifted attention away from conservation efforts, prioritizing the socio-political issues and leaving environmental concerns in the background.

Despite these setbacks, Socotra's readiness for sustainable tourism is apparent, and the foundations provided by its conservation plan, established in 2000, are already in place. The Presidential Decree #275 of 2000 details Socotra's land uses, including Resource Use Reserves, General Use Zones, National Parks, Areas of Special Botanical Interest, and Nature Sanctuaries, all of which work to organize local activity and be supervised by the Environment Protection Council within the island. The decree also organizes what is prohibited from entering the islands,

[48] Slak Valek, Nataša, et. Al. "Potential for Tourism in Emerging Destinations: Case of Socotra Island."
[49] Scholte, Paul, et. al. "When Conservation Precedes Development: A Case Study of the Opening up of the Socotra Archipelago, Yemen."

including non-native seed species not tested by trusted scientific parties.[50] What is now needed is proper funding and further research to ensure that conservation policies are followed through effectively. Future development must not only meet the minimum standards of environmental preservation provided by the conservation plan, but should also go beyond its regulations to create a cohesive relationship between Socotra's people, nature, and tourism. By doing so, the island has the potential to introduce development that gives back to both the environment and its local communities, ensuring a sustainable and cohesive future.

In addition to the conservation plan and EPA initiatives, Socotra underwent a lengthy process to achieve UNESCO World Heritage designation, similar to that of Old Sana'a's listing, as a way to secure its long-term conservation. Socotra's UNESCO application process, which began in the early 2000s, involved gathering various stakeholders, including local officials and international conservation experts, to discuss the island's natural value and future. By 2008, UNESCO officially recognized Socotra for its rich biodiversity, with a strong focus on its endemic species and unique ecosystems that also closely tie in with Socotrans' local heritage.[51] This designation was a major milestone for Socotra, as it not only safeguarded its natural habitats from potential destruction or misuse but also brought global attention to the island's ecological significance. The recognition, along with the island's conservation plan, helped protect Socotra from harmful practices, such as the introduction of invasive species or unsustainable exploitation of its resources. Additionally, the

[50] The Republic of Yemen: Environmental Protection Council. "Conservation Zoning Plan of Socotra Islands (Socotra, Samha, Darsa, Abd Al Kuri, and associated small islands rocks and rock outcrops)"
[51] UNESCO. "Examination of nomination of natural, mixed and cultural properties to the World Heritage List - Socotra Archipelago (YEMEN)."

UNESCO designation raised important questions regarding the island's development and how to balance conservation with responsible growth. As discussions about Socotra's future progressed, the limits and scope of development became points of concern, particularly regarding how both UNESCO officials and Socotran residents could sustainably manage tourism and infrastructure.[52] These issues gained even more relevance in the years following the beginning of political instability in Yemen post-2011, which affected the island's ability to fully implement its conservation strategies and developmental goals due to divided attention.

The "Sustainable Development and Biodiversity Conservation" guidelines is an additional preventative planning initiative developed by the UNDP in collaboration with Yemen's Ministry of Water and Environment has also been instrumental in identifying potential development areas while ensuring they are zoned and funded responsibly based on responsible Socotran practice. A focus of the plan is the consideration of micro and macro strategies for economic growth for the island, such as the development of fisheries, as well as detailed financial plans to support these initiatives.[53] By focusing on development, the plan aims to ensure that conservation efforts are equitable and sustainable. The implementation of financial studies conveys a clear understanding of the need for well-funded, long-term conservation efforts, which should also be reflected in upcoming developments that involve tourism, as multiple international entities will be interested in their investment. Additionally, the conservation zones, and following conservation

[52] Peutz, Nathalie. *Islands of Heritage: Conservation and Transformation in Yemen.*
[53] The Republic of Yemen: Ministry of Water and Environment. "Sustainable Development and Biodiversity Conservation for the People of Socotra Islands, Yemen."

proposals, offer valuable insights for future architectural design, informing where and how new structures can be developed. While large-scale development was not initially prioritized, embracing it in a sustainable way could promote the growth of Socotra's economy, improving the livelihoods of those who live there.

However, despite these plans for conservative development, much of their implementation remains impractical due to accessibility and compliance issues. For example, as stated in a previous subsection, many of the ideal locations for nature reserves, particularly for afforestation efforts, are inaccessible because of the island's sloping landscape. As referenced by Rezende, studies comparing artificial afforestation on islands such as the Canary Islands and Cape Verde concluded that only 25% of Socotra's land is suitable for the dragon blood tree's requirements. However, the challenging terrain limits the usable area.[54] Given these and similar findings, careful planning is needed to identify and review truly suitable conservation areas, and assess whether local activities, such as excessive livestock grazing and loss of agricultural traditions, are as detrimental as is presumed, compared to naturally constricting environments. This calls for the establishment of suitable developments that can host welcoming environments for plant research and refugia, such as seed nurseries and research laboratories, which could help maximize Socotra's conservation potential.

Finally, such inadequate constraints placed on Socotran practice by conservations have made the tension between officials and locals grow due to a

[54] Rezende, Marcelo, et. al. "Identifying Suitable Restoration and Conservation Areas for Dracaena Cinnabari Balf. F. In Socotra, Yemen," 1276.

perceived lack of understanding and communication. Locals, who typically strive to expand their agricultural and economic activities, feel restricted by conservation policies imposed by officials who assume they know what's best for the island, while negating the credible age-old Socotran tradition of maintaining their land. This disconnect has gradually stunted local economic growth and increased frustration regarding locals' autonomy.[55] On the other hand, given the recent political turmoil following 2015 in Yemen, conservationists have not continued to provide sufficient engaging or educational opportunities to the local population about the importance of conservation strategies, and how they might be reviewed by ongoing local involvement.

During its earlier conception, the conservation plan implemented a thorough sequence of educational programs that helped bridge this communication gap. The core issue could lie in a lack of mutual understanding, where locals and conservationists are striving for different goals, economic and natural, respectively, which are both important in their own right. However, to resolve this tension, there needs to be a renewed focus on collaboration through educational initiatives and communal engagement.[56] This would not only expose locals to the value of conservation but also encourage conservationists to embrace a bottom-up approach. By working together and understanding each other's motives, both groups can achieve sustainable progress that benefits the island, socially, economically, and environmentally.

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[55] Peutz, Nathalie. *Islands of Heritage: Conservation and Transformation in Yemen.*
[56] *Tourism at World Heritage Sites, Challenges and Opportunities: International Tourism Seminar : ÇEşMse (Izmir), Turkey.*

Conclusion

What can be deduced from the discussed subtopics is Socotra's need for development strategies that not only address its need for economic generation through tourism, but also the need for the island's locals to feel engaged and autonomous within its governance and outreach. This architectural thesis aims to integrate both approaches to bridge the gap between conservationists, locals, and tourists alike. This is to be done with great consideration of previous eco-tourism models and the sustainable lessons that can be gained from their outcomes; such as those present in Fuerteventura Island, Canary Islands, Spain; Sal Island, Cabo Verde; Masirah Island in Oman; Palau Island, Oceania; Galapagos Islands, Ecuador. Using these case studies, which will be further explored in the [*Precedents*] chapter, will help inform the architectural manifestation of the needed development, as well as its beneficial program.

Chapter 3: Methodologies

Socotra, Yemen, is an island of great historical and geographic significance, providing a rich range of research methods throughout this thesis. Despite its natural and ecological diversity, Socotra remains relatively underexplored in terms of architectural approaches. This is largely due to the island's sparse built environment, with the majority of its architectural developments concentrated in major urban cities, like Hadiboh and Qalansiyah, distant from the natural sites that draw significant research and tourism interest. The architectural literature on Socotra is limited, especially due to the island's conservation plans that limit development in the island's rural and ecologically sensitive areas, leaving a notable gap that this thesis seeks to address.

Much of the existing quantitative research on Socotra has historically focused on its plant biodiversity, drawing on contributions from biologists and botanists since the mid-20th century. Socotra's vegetation, which includes numerous endemic and endangered species, has been well-documented through studies conducted by researchers from the United Kingdom, Switzerland, the Netherlands, the United Arab Emirates, and other countries. This established research forms a robust foundation of scientific knowledge regarding the island's unique ecological makeup. These studies have provided critical quantitative data that informs not only environmental policies and regeneration methods, but also tourism development, as Socotra's biodiversity is a primary draw for eco-tourists and researchers alike. Therefore, understanding this

ecological context is essential to designing architectural solutions that respect and enhance, rather than degrade, the natural environment.

Following the outbreak of conflicts in Yemen's mainland in 2015, Socotra has had a surge in ethnographic studies aimed at understanding its social concerns, political landscape, and conservation practices' impact on local communities. These studies have begun to fill gaps in the literature by exploring the social, cultural, and political factors that influence the island's development. The studies have also had a focus on direct local perspectives on tourism, conservation, and economic development, revealing the complex relationship between the island's workforce and its nature. This research has brought a variety of concerns that need to create a balance between preserving Socotra's environment and meeting the needs of its residents. This emerging body of qualitative research provides valuable context for this thesis, allowing for a more nuanced exploration of how architecture can address both local priorities and environmental preservation.

The research methodology for this thesis will strategically blend both Socotra's quantitative and qualitative approaches, drawing on past, ongoing, and recent studies to support a holistic and interdisciplinary approach. Quantitative data from ecological studies will ground the research in scientific facts, offering essential details into the island's environmental conditions and the potential impacts of architectural low or high impact interventions. Meanwhile, qualitative data gathered from recent ethnographic researchers will highlight the human and cultural dimensions of Socotra's development needs.

To provide a first-hand approach to ethnographic work, additional fieldwork will be conducted to enrich this research, including potential interviews with Socotran officials and stakeholders in the island's tourism department, which can answer specific thesis questions that tailor to the architectural development, which has not yet been explored in length. These interviews are expected to provide valuable first-hand insights into the aspirations and challenges of local constituents, particularly those directly involved in the tourism industry. Understanding the perspectives of these key stakeholders on architectural interventions is crucial to designing solutions that are not only ecologically sensitive but also socially and economically beneficial.

As mentioned, despite the progress made in ecological and social research, architectural studies on Socotra remain constrained, particularly due to the conservation regulations implemented in the year 2000. These regulations restrict development within ecologically significant zones to prevent degradation of Socotra's biodiversity. While essential for environmental preservation, these limitations could potentially negatively impact said protected areas due to lack of facilities and tourist accommodations in tourist-heavy destinations. This thesis, although not strictly bounded by these sites, will explore any potential opportunities for protected sites to intake low-impact or minimal built development that can serve as a solution for Socotra's development-tourism imbalance, without overdeveloping the sites. This thesis will work within these constraints, exploring design solutions that respect Socotra's regulatory framework while offering the island a tailored solution that can prevent its negative overdevelopment.

Overall, this thesis aims to develop an interdisciplinary approach that bridges architectural inquiry with ecological and ethnographic research. By leveraging both quantitative and qualitative data, the thesis seeks to propose architectural strategies that meet Socotra's unique needs—preserving its nature while supporting sustainable tourism. Through a blend of scientific literature and cultural studies, Taking Root will strive to fill the gap in architectural knowledge on Socotra, contributing to a future where development and conservation exist with the locals at the forefront of its solution goal.

For architectural-discipline research, this thesis will reference case-studies that have similar social and environmental needs and challenges in other regions that can aid Socotra's design solutions' long-term impacts and risk management. The case studies vary based on which similarity they share with Socotra and their potential application to this thesis solution. This categorization is dependent on the following:

- Setting: City or Island destinations
- Tourism Development Status: Developed, Developing, or Re-developed.
- Climate Conditions: Transitional Desert Climate, Desert Climate, or Tropical Climate.

Not all case-studies will fit with Socotra's setting, tourism development status, or its climate conditions, but each case-study can help Socotra's approach for development and degradation mitigation. Case-study examples range from those directly adjacent to Socotra's region, such as Masirah Island in the Sultanate of Oman, which can be geographically proximate but climatically contrasting, or Fuerteventura Island in the Canary Islands, Spain, which might be an intermediate

distance form Socotra but with similar climatic conditions. Moreover, while Masirah Island has a humid climate, its development status is similar to that of Socotra's, in that its developments can help inform how its solutions were able to address the local, economic, and natural determinants that are also similarly prevalent to the island of Socotra. Conversely, although Fuerteventura Island might have a similar climate to that of Socotra, its development far exceeds that of Socotra and can hold great insights on the impacts of tourism and climate change in a relatively overpopulated land. Utilizing a variation of these case-study locations will inform the overall strategy upon developing Socotra, as well as inform the selection of the design solution's program, the influencing architectural precedents, and the site in which to implement said potential programs.

The selection of Socotra's program (Summarized as the following program zones: *Environmental Conservation, Professional Development, Tourism Development, Sustainable Infrastructure, and Communal Engagement*) was heavily informed by its ethnographic studies, which have also been reaffirmed by direct recorded feedback from local communities, tour guides, and Yemeni tourism and conservation officials. Such ethnographic studies range from surveying, interviewing, and more interactive and/or interventive workshops that allow for evaluative feedback at their conclusion. Architectural precedents are then accordingly selected to provide lessons for one or more aspects of each of the aforementioned program zones, such as how Alioune DIOP University Unit in Bambey, Senegal, inspires the design of professional developmental spaces that are also enclosed by sustainable building

envelopes (infrastructure), and other links that will be further explored in the [*Precedents*] Chapter.

The site selection, both working as a response and a refinement to the program selection, will then be investigated using GIS data analysis as well as additional ethnographic studies based off of tour guides' and tourism officials' insights on suitable tourism development sites. The site will be based on the avoidance of any nature sanctuaries that are protected according to the conservation plan's protected zones, as well as the geological makeup of Socotra's land, choosing a site that is void of drastic sloping landscapes that will require significant excavation to provide accessible user routes. The site's inclusion of local communities will be held on a case-by-case basis, with strict evaluations on the potential solution's impact on said community's displacement, and its contrasting likelihood to provide better conditions for remote villages beyond Socotra's major cities. Infrastructure, including the pavement of roads and connections to electricity and telecommunications, will be evaluated as well on each chosen site, as well as the site's potential to provide alternate material sourcing for more sustainable infrastructural and architectural designs. Finally, due to Socotra's oscillating climatic conditions, the site will also need to be evaluated by its adjacency to sensitive regions to the island's windy and rainy monsoons.

Finally, through the utilization of quantitative research provided by natural data and regional case-studies, as well as qualitative research provided by Socotra's local and/or official populations, this thesis will explore architectural solutions that can apply to the island as well as avoid any potential negative impacts that can be

studies from preceding tourism projects in other destinations. With such investigation, the thesis program and site selections are respectively informed by internationally recognized environmentally and socially equitable projects, and a robust evaluative analysis of potential benefits and risks to Socotra's land.

Chapter 4: Precedents

Introduction

Although Socotra carries a rich history in its local origins, which is reflected in Socotrans' lifestyles and cultural norms, much of Socotra's architecture remains relatively simple in its landscapes. Most Socotran architecture offers users the basic necessities of enclosure and protection from the elements, but it limits its imagery and more enhanced enclosures to the island's mosques. Most buildings also host traditional layouts for their settings, without a variety of public records referencing how they are constructed, with which layouts, and for which stakeholders. Therefore, a successful design solution to Socotra's ecotourism development requires extensive research on a variety of case studies that have climate, cultural, and programmatic needs similar to those of Socotra.

However, as mentioned in this thesis' [*Literature Review*] Chapter, eco-tourism in Socotra can only be effective if it is accompanied by sustainable tourism practices. Socotra currently has an effective eco-tourism strategy, although it can be improved with greater integration of visitor-local interaction. The island is also relatively void of significant tourism development, which, if developed without a focus on sustainability and resiliency, can negatively impact the island's nature and its residents. Therefore, an initial examination of various developed eco-tourism destinations took place to better inform Socotra's approach to tourism. The investigated case studies, exclusively island-based, were chosen because of their social and environmental challenges and solutions' similarity to those of Socotra, and

their insight on how Socotra can include eco-tourist strategies that have proven successful in similar locations. Of all the islands investigated, the following are most useful to Socotra's design solution; Palau, Oceania; Fuerteventura, Canary Islands, Spain; and Sal, Canary Islands, Spain.

Beyond regional case studies, a set of architectural projects was chosen to address Socotra's programmatic and environmental needs in the built form. The architectural precedents have been selected due to their being deemed phenomenologically applicable by the author, or for their recognition by credible organizations for their equitable and successful design implementation. Each precedent is featured for achieving a great design that exceptionally succeeds in one or more of the following criteria:

- Low Impact Site Design
- Equitable Programming
- Sustainable Infrastructure
- Resilient Building Envelope
- Innovative Technology

The selection criteria resulted in the featuring of the following precedents: Friendship Center, Bangladesh; Alioune Diop University Unit, Senegal; Wadi Hanifa Wetlands, Saudi Arabia; Green Planet, UAE; and most notably, Women's Opportunity Center, Rwanda. Such precedents apply to Socotra by incorporating the provided criteria in sustainable methods, especially with their focus on communal benefit. All case studies were examined through various research, including qualitative data accounts by designers and end-users, and, when made available,

quantitative data provided by designers, third-party engineers, or peer-reviewed sources.

Regional Case Studies

Palau, Oceania

Fig. 4.1- Palau Pledge.
Source: PALAUPLEDGE.COM. “Palau Pledge.”

Palau faces the challenge of balancing tourism development with environmental conservation due to over-tourism, which can benefit Socotra in identifying signs of over tourism and finding mitigative strategies to avoid its prominent occurrence.

Tourism in Palau, which contributes around 40% of the island's GDP, has led to environmental strain, especially following a peak of 163,905 visitors in 2015. The government and residents agree on shifting toward high-end tourism and implementing active environmental protection strategies, such as the Palau Pledge.[57] [58] [59]

The Pledge, established in 2017, creatively addressed over-tourism's environmental impact by requiring visitors to sign a pledge to the children of Palau on their passport upon arriving to the island, pledging to protect the children's home's ecosystem. Initiated by four local activists and supported by innovative advertising services, the campaign garnered global recognition, winning multiple prestigious awards. The Palau Pledge was made an immigration requirement, and encouraged responsible tourist behavior, significantly influencing visitor attitudes toward environmental conservation. The campaign gained widespread media attention, with 280,000 pledges and a reach of 1.7 billion impressions. It became a model for sustainable tourism, inspiring similar initiatives in other countries.[60]

The implementation of a similar conservationist pledge that is tailored towards Socotra and its locals can also be implemented through UNESCO's efforts and can be successful. This is especially true for Socotra's tourist audience, which majorly

[57] Levitan-Haffar, Marcia Moana. "Can Nature Tourists Police Themselves? Comparing Eco-Pledges in the United States and Palau." U. Colo. L. Rev. 93 (2022): 801.
[58] Lee, Po Yen, Lin Qi, and Peng Li. "Host community attitude toward trade-off between tourism development and environmental conservation: a case study of Palau." Bus. Manag. Res 9 (2020): 21.
[59] Medel, Ismael Lopez. "The Palau legacy pledge: A case study of advertising, tourism, and the protection of the environment." Westminster Papers in Communication and Culture 15, no. 2 (2020).
[60] Medel, Ismael Lopez. "The Palau legacy pledge: A case study of advertising, tourism, and the protection of the environment." Westminster Papers in Communication and Culture 15, no. 2 (2020).

consists of eco-tourists who are willing to compromise luxuries or some activities for the sake of witnessing the island's nature in its purest form.

Canary Islands, Spain

The Canary Islands, particularly Fuerteventura and Sal, provide crucial insights into the impacts of tourism development relevant to Socotra. Fuerteventura's Sotavento beaches have experienced a landward shoreline retreat of around 62 meters due to tourism resorts' effects on coastal sediment transport. These disruptions are compounded by paved roads, sand extraction, and gardening, which prevent sediment from replenishing the coastline. This scenario suggests that if Socotra develops its beaches, sustainable accommodation typologies should be considered to avoid such erosion. Socotra's unique appeal depends on its beaches, and blocking infrastructure-driven damage early on is essential to preserving its tourism potential.[61] [62]

On Sal Island in Cape Verde, similar concerns emerge around economic and social imbalances in tourism. Immigrant-owned businesses in sun-and-beach destinations often overshadow local businesses, leading to an increased disparity between residents and external entrepreneurs. It is also worth noting that locals fear tourism's impacts on living costs and its lack of regulations, despite recognizing the process of tourism as a revenue source, although some all-inclusive packages isolate tourists from local culture, creating divides and limiting local benefits.

[61] Alcántara-Carrió, J., and L. Cabrera. "Tourist resorts and their impact on beach erosion at Sotavento beaches, Fuerteventura, Spain." Journal of Coastal Research 36 (2002): 1-7.
[62] Castillo Canalejo, Ana María, Julia M. Núñez Tabales, and Sandra María Sánchez Cañizares. "Local community perceptions on tourist impacts and associated development: A case study on Sal and Boa Vista Islands." training (2016).

The Canary Islands' case studies prompt Socotra's tourism development to address environmental preservation and socio-economic inclusivity. By learning from the Canary Islands' locals' experiences, Socotra can craft policies and infrastructure that prioritize sustainable practices, support local entrepreneurship, and foster meaningful visitor-local engagement, ensuring that tourism benefits both the environment and residents.

Other Notable Regional Case Studies

- Iran's fast tourism.
- Galapagos' restricting access and displacement.
- Veracruz' sun sea and sand tourism.

Architectural Case Studies

Friendship Center, Gaibandha, Bangladesh

Fig. 4.2. Friendship Center, Bangladesh.
Source: Aga Khan Development Network. "Friendship Centre."

Designed by Kashef Chowdhury/URBANA, and completed in 2011, the Friendship Centre in Gaibandha is a 30,000 SF educational and training facility built for the Friendship NGO in Bangladesh that aims to increase professional literacy amongst poor populations inhabiting riverine islands, also known as chars. The center is a design of cubic pavilions and rooms that are woven with squared planting plots and cooling pools.[63] The Friendship Center's most beneficial aspects to Socotra are its site integration and spatial and communal programming.

The center's development was assigned within a site that is prone to flooding and earthquakes, creating the need for effective water run-off management and relatively low and strong building foundations. As a result, the center was designed within a rectangular embankment that retains its position below flooding grade, effectively burrowing the design beneath the site and resulting in a conservation of its

[63] Ibid.

site views, further improving the privacy of Friendship's stakeholders. The design also uses simple yet effective sustainable techniques, such as rainwater harvesting and earth-insulated walls that naturally regulate indoor temperatures. Said walls are majorly made of locally handmade bricks, which were inspired by Bangladesh's earliest archaeological site, the Mahasthangahr ruins, located around 60km from the Center.[64]

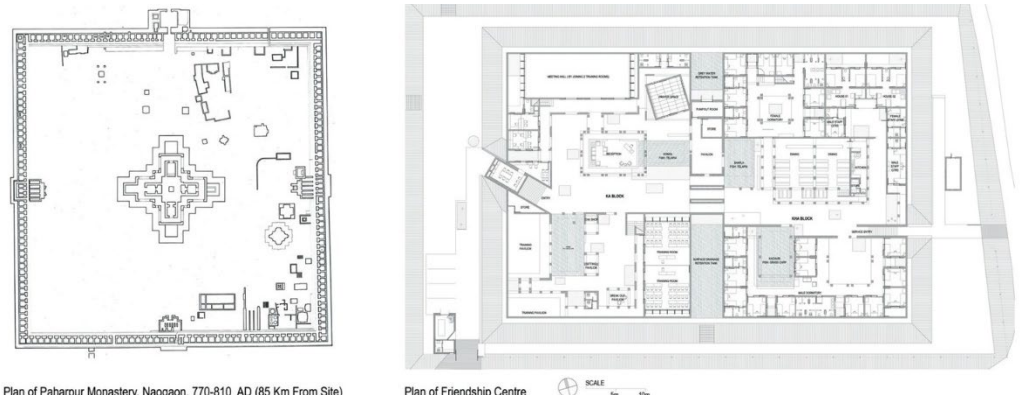

Fig. 4.3 - Friendship Center's Floor Plan and Inspiration Paharpur Monastery Ruins.
Source: Aga Khan Development Network. "Friendship Centre."

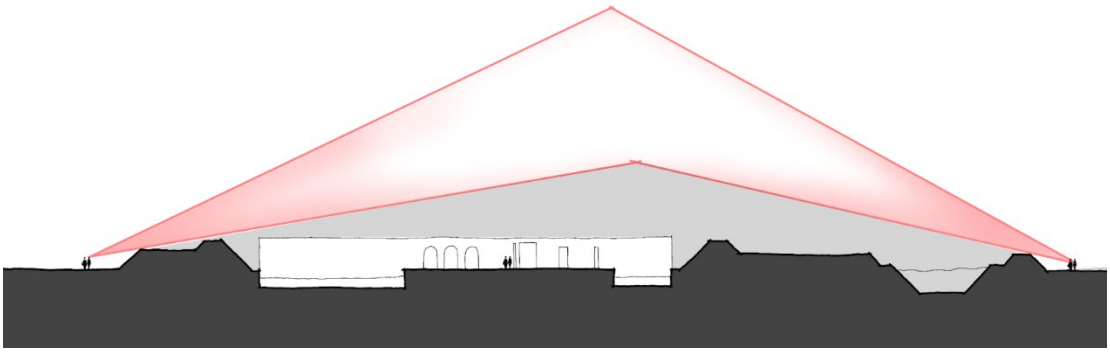

Fig. 4.4 - Friendship Center's Discrete visual placement on site.
Illustrated by author.

[64] Aga Khan Development Network. "Friendship Centre." Accessed November 3, 2024. https://the.akdn/en/how-we-work/our-agencies/aga-khan-trust-culture/akaa/friendship-centre.

Just as the Friendship Center's formal design addresses its site's needs, its program does the same for its stakeholders. The center is split into two halves; a public-facing segment named the "Ka" block, which hosts classrooms, offices, a resource library, and a prayer room; and a private residential segment called the "Kha" block, which hosts a dormitory separated for men and women, as well as a dining hall. Both segments benefit Friendship's stakeholders through income-generating facilities such as classrooms that can fit 80 people at once, as well as culturally equitable spaces that can provide shelter for the poor population during the hosting of Friendship's workshops.[65]

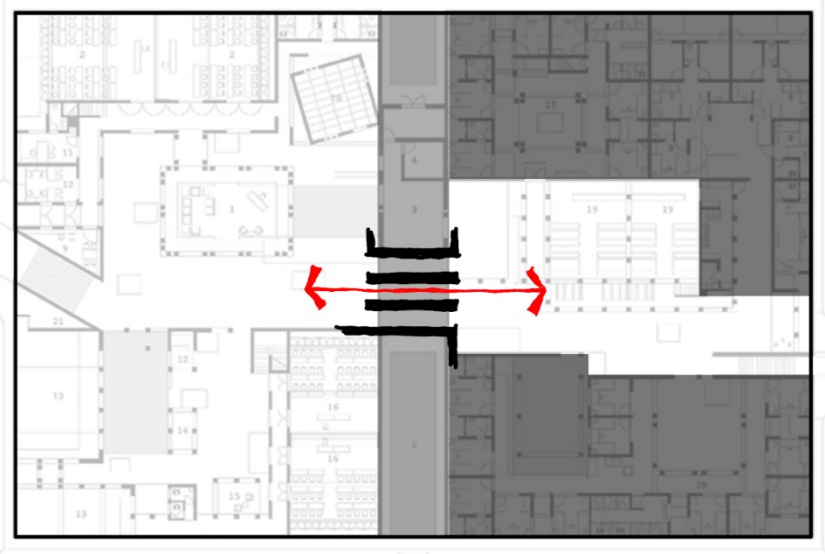

Fig. 4.5 - Friendship Center's Public vs. Private Segmentation.
Illustrated by author.

With a focus on integrating the design motives with the circumstances and goals of the site, as well as empowering communities through education, the Friendship Centre offers solutions on how Socotra's architectural design can

[65] Ibid.

prioritize both its social and environmental sustainability while maintaining economic generative activity. Applying archeological inspiration within the Friendship Center's design can also bring innovative solutions to Socotra's formal designs, which can refer to its historical origins and similar pasts. Socotra's incorporation of local and tourist stakeholders when designing lecture halls can also help integrate the two groups together for similar motives.

Alioune DIOP University Unit, Bambey, Senegal

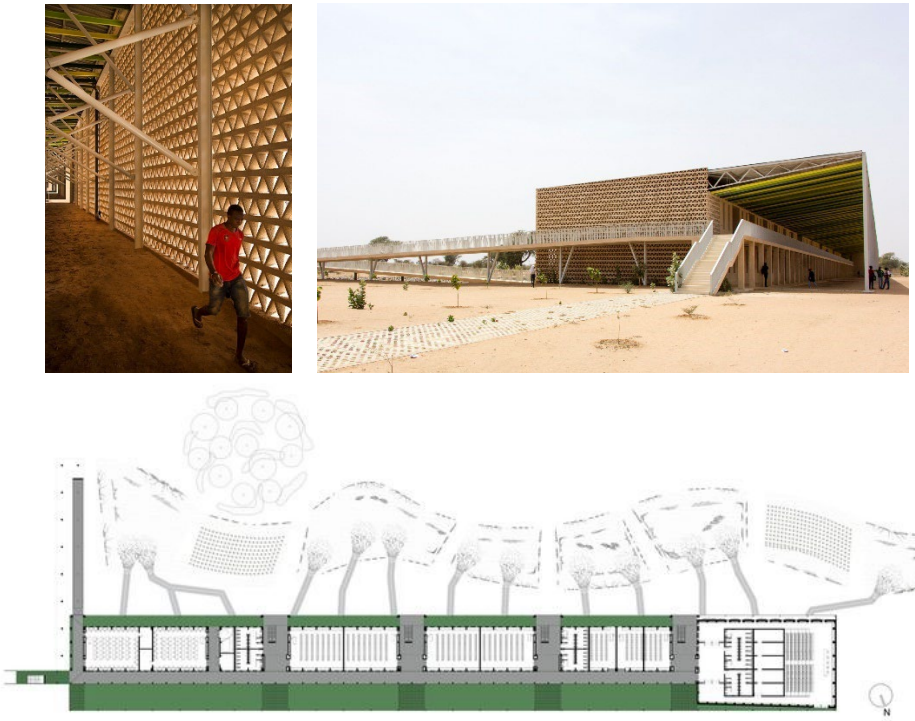

Fig. 4.6. Alioune DIOP University Unit.
Source: Aga Khan Development Network. “Alioune Diop University Teaching and Research Unit.”

Designed by IDOM and completed in 2017, this unit is an 80,000SF teaching and research center for Alioune University in Bambey, Senegal. It was developed due to Senegal’s government initiative to increase rural higher education and the World Bank’s financial support. Alioune was to expand its campus as its smaller block academy buildings had reached their student capacity. The new project contains a variety of lecture halls, computer classrooms, laboratories, and more. In addition to its program’s laboratories’ applicability to Socotra’s plant research needs, IDOM’s design of the building through its cross-section, inspired by the project site’s trees

used for their shade and cooling strategies, is Alioune's strongest use of Socotra's design solution for its environmental integration.[66]

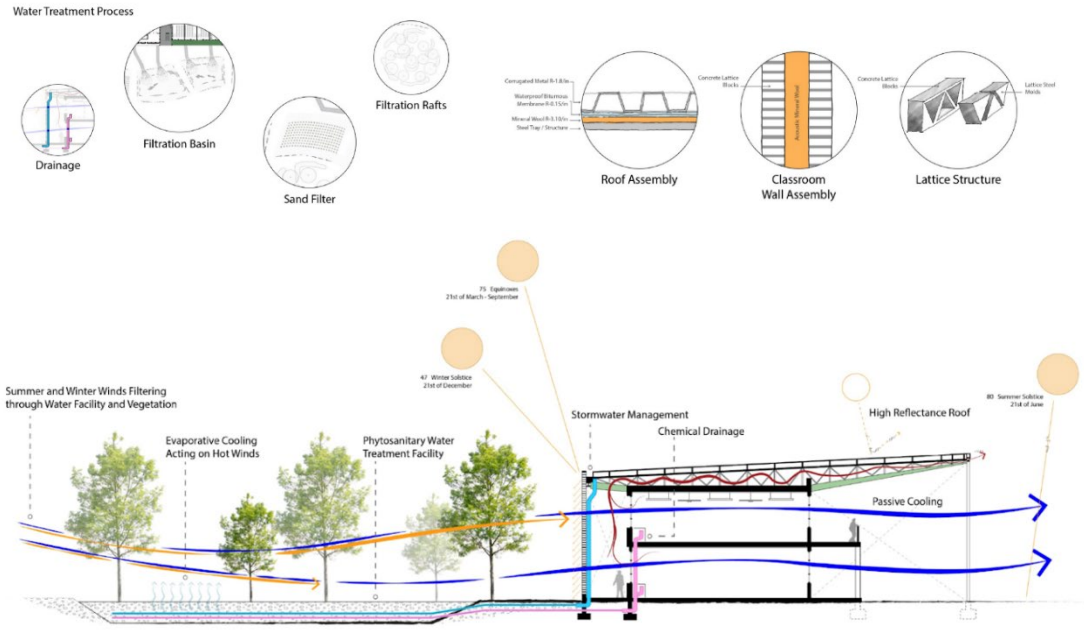

Fig. 4.7 - Alioune Diop's Comprehensive cross-section.
Illustrated by author.

Alioune's building envelope highly focuses on minimizing energy use through passive cooling strategies, making it highly sustainable in the hot, arid Senegalese climate, which is also similar to that of Socotra (transitional desert, where the typically arid climate switches to that of heavy and consistent rain). The building uses locally made materials, such as envelope clay and brick, which were molded using the site's own materials and provided natural insulation via a screen wall throughout the entirety of its wind-directed wall. Additionally, the cross-ventilation techniques

[66] Aga Khan Development Network. "Alioune Diop University Teaching and Research Unit." Accessed November 3, 2024. https://the.akdn/en/how-we-work/our-agencies/aga-khan-trust-culture/akaa/alioune-diop-university-teaching-and-research-unit.

and strategic window placements reduce the need for mechanical cooling within the building.

This research center was also to be developed adjacent to one of Senegal's rural agricultural districts, where essential infrastructure, including electricity, wastewater management, and paved roads, was majorly underdeveloped, which is somewhat similar to Socotra's rural situation. To combat the lack of infrastructure, the designers implemented a self-sustaining cycle in which the laboratories' waste would be transferred to the center's bordering site, which hosts infiltration rafts and low-maintenance vegetation that naturally cycles and purifies wastewater, which is stored in on-site cisterns, and can be reused as grey water within the center.[67]

Overall, through the use of an adequate cross-section, Alioune's university unit was able to achieve a high-efficiency utility rating with minimalist strategies that can raise the unit's efficiency beyond what its population could have afforded. This method is beneficial to Socotra's design solution, as Socotra's lack of infrastructure is best dealt with on an off-grid basis, especially due to its conservation zoning that typically interferes with most development linking to major utility hubs in major cities.

[67] ArchDaily. "Lecture Building at the Alioune Diop University / IDOM," May 15, 2018. https://www.archdaily.com/893667/lecture-building-at-the-alioune-diop-university-idom.

Wadi Hanifa Wetlands, Riyadh, Saudi Arabia

Fig. 4.8 - Wadi Hanifa Wetlands' Photographs.
Source: "Riyadh Bioremediation Facility | Landscape Performance Series."

Designed by Moriyama & Techima Planners for Arriyadh Development Authority, Wadi Hanifa is a large-scale wastewater bioremediation project, completed in 2009, that transformed an once brownfield within Riyadh's Wadi Hanifa watershed into a vibrant ecological community zone. The half mile-length facility was developed as a response to growing development in the city that degraded the natural capacity of the valley. It relies on technical flood management and wastewater treatment facilities which utilize natural hydrological systems to restore the degraded landscape.[68] This bioremediation technique is what is most applicable in terms of closing Socotra's infrastructural development off-grid.

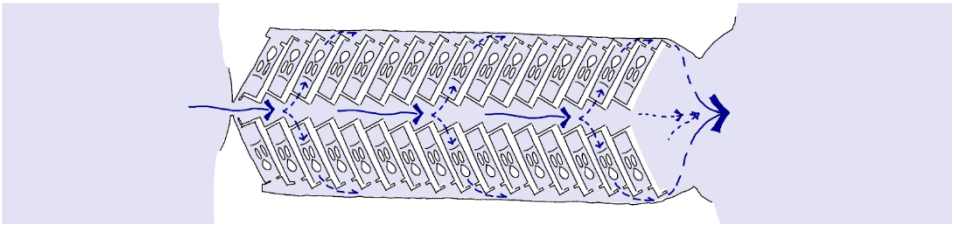

Fig. 4.9 - Wadi Hanifa Bioremediation Cell Water Flow.
Illustrated by author.

[68] "Riyadh Bioremediation Facility | Landscape Performance Series," October 15, 2015. https://www.landscapeperformance.org/case-study-briefs/riyadh-bioremediation-facility.

The bioremediation facility is composed of 3 sequential groups of a total of 134 bioremediation cells. Each cell incorporates oxygenation that reduces coliform bacteria concentrations and creates adequate conditions for aquatic species, such as tilapia fish, which consume wastewater nutrients and further clarify it upon recycling. This methodology, which is expanded to fit the extent of the city's wastewater management demand, allows the cells to process a daily average of 92 million gallons of wastewater. Additionally, educational programs are hosted for the community to educate residents on the facility's methodology, as well as an incorporation of a wet laboratory on site that allows for the facility's monitoring, which has proved to reduce coliform concentrations and water sedimentation to near 100% levels.[69]

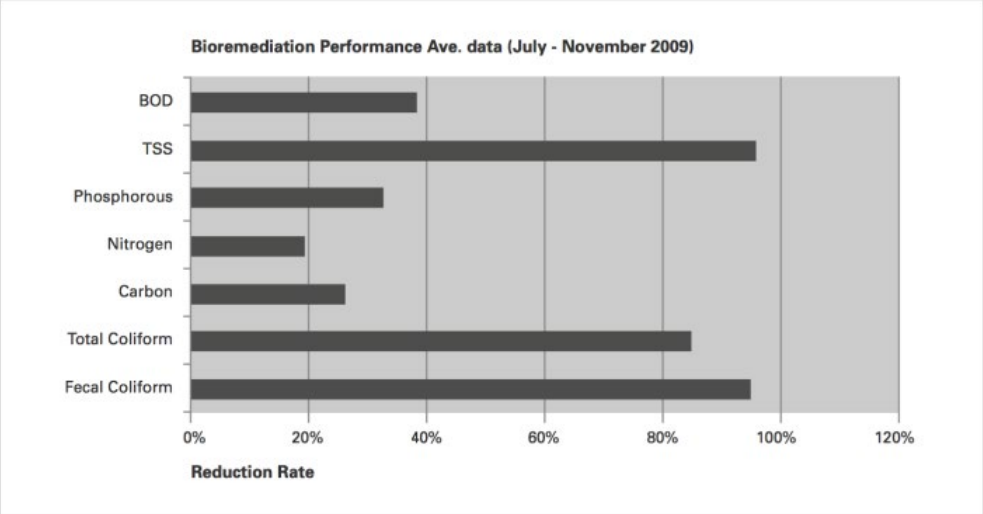

Fig. 4.10 – Bioremediation Performance Ave. data (July – November 2009). Source: "Riyadh Bioremediation Facility | Landscape Performance Series."

The sustainable features, including stormwater management and the natural purification of wastewater through wetlands, have made Wadi Hanifa an example of

[69] Ibid.

how Socotra can allow infrastructural locations to coexist with natural ecosystems while improving biodiversity and ecological health. Granted, Riyadh's facility was established on what was previously a brownfield, however, Socotra's wastewater management will be at a much smaller scale and can be limited to semi-artificial built forms that limit interaction between the natural streams and man-made water sequence, to further its conservation and avoid any contamination beyond the island's development scope.

The Green Planet Dubai, Dubai, U.A.E.

Fig. 4.11 - The Green Planet Dubai's Photograph, Floor Plan, and Section. Source: GMA - Editor Version. "The Green Planet | Grout McTavish Architecture."

Designed by Grout McTavish Architects for the public and completed in 2016, the Green Planet Dubai is a 60,000 SF science center, that the author has phenomenologically evaluated, which includes a rainforest biodome that replicates an equatorial rainforest environment within Dubai's desert setting. Aside from its rainforest biodome, it includes a variety of programs tailored toward educating the public on the need for a sustainable future in protecting the environment, such as classrooms for the youth, and an aquarium exhibit. However, the most prominent

lesson to be learned from Socotra's thesis is the Green Planet's accomplishment of a varied interior climatic experience that is independent of Dubai's desert setting.[70]

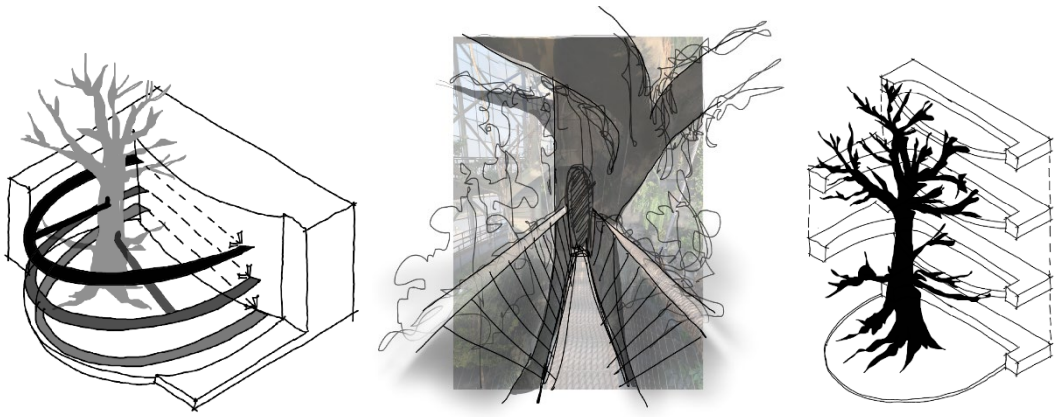

Fig. 4.12 - The Green Planet's Promenade and Core Design.
Illustrated by author.

The Green Planet uses robust thermal control via its building envelope, despite its significant glazing transparency, to maintain the microclimate necessary for an equatorial rainforest. This environmental shield is achieved by implementing vertical gardens that promote evaporative cooling; site-specific water recycling systems, used for misting the entirety of the rainforest biodome, that extend the city's water facilities grid to the high needs of the museum; and energy-efficient climate controls, which were coordinated by both architect and MEP engineers with full design integration of aesthetic and technical systems. Despite the museum's high energy loads required for climatic changes in various programs, the overall building promotes environmental education while minimizing its ecological footprint, by controlling energy usage and maintaining a delicate ecosystem inside the dome.[71]

[70] GMA - Editor Version. "The Green Planet | Grout McTavish Architecture." Accessed November 3, 2024. https://www.groutmctavish.com/the-green-planet.
[71] Buro Happold. "Green Planet Dubai." Accessed November 3, 2024. https://www.burohappold.com/projects/green-planet-dubai/.

Although extreme in its own case, the Green Planet Rainforest demonstrates how urban developments can host biodiversity in arid climates, offering a model of how sustainable technologies can simulate and protect natural habitats, especially those most beneficial to Socotra's endemic plant species growth. Utilizing at least modified versions of the Green Planet's mechanical manipulation can fit an optimized interior growth lab in Socotra.

The Women's Opportunity Center, Kayonza, Rwanda

Fig. 4.13 - The Women's Opportunity Center's Photographs and Floor Plan. Source: BrickArchitecture.com. "Women's Opportunity Center / Sharon Davis Design."

The Women's Opportunity Center, designed by Sharon Davis Design in 2013, is a community and training facility focused on empowering Rwandan women in their pursuit of professional development. All of the project's aspects can effectively influence Socotra's design, for all of its participatory, aesthetic, programmatic, and communal approach. The overall site of the center was focused on a fertile portion of the region that can host agricultural functions, as most of the adjacent communities focused on rural farming techniques. Built using compressed earth blocks made by the initial organization's women in training, the construction remained minimally

impactful to the site, without great imposing foundations and light enclosures that blend with the outdoors to create more feasible construction methods.[72]

Within the site's forms, the center consists of a self-sustaining program that includes training classrooms, gathering halls, administrative and staff facilities, agricultural fields, guest lodges, and a market. Such programming allows women from various backgrounds to utilize the center's resources, harvest their professional skills, and finally sell them in the public-facing market hall. Staff and some women also have the opportunity to dorm within the ground for extended workshop periods.[73]

Fig. 4.14 - Women's Opportunity Center Programmatic Site Overview.
Illustrated by author.

[72] "A Detailed Review of the Women's Opportunity Center in Rwanda by Sharon Davis Design - Livin Spaces," August 25, 2017. https://livinspaces.net/design-stories/featured-projects/cultural-and-religious/a-detailed-review-of-the-womens-opportunity-center-in-rwanda-by-sharon-davis-design/.
[73] Ibid.

Fig. 4.15 - Women's Collaborating in one of the site's conference rooms. Source: BrickArchitecture.com. "Women's Opportunity Center / Sharon Davis Design."

The Center employs a multitude of sustainable yet feasible strategies when reflected upon Socotra's design solution, such as natural ventilation through building envelope screens, rainwater harvesting in underground cisterns, and a biogas system that converts waste into cooking energy. The circular pavilions' perforated brick facades incorporate passive cooling that reduces energy needs, while their flanked metal roofs capture rainwater for multiple activities, including on-site agricultural practices that support food security.[74]

Additionally, the incorporation of flexible spaces, both indoor and outdoor, within the Center's grounds helps facilitate greater local-visitor interaction that also promotes the organization's end-user experience in developing relationships beyond their community circles, including but not limited to the Women's high sales

[74] Ibid.

interaction with tourists or event visitors in the market hall, or trainees' collaborative working opportunities in partner breakout meeting rooms.[75]

Overall, the comprehensive approach of the Women's Opportunity Center to communal and sustainable methodologies is greatly beneficial to that of Socotra's design. The project's program is also relatively similar to Socotra's needs and challenges, and it can be of similar size as well. The infrastructural development, therefore, can be scaled to Socotra's own infrastructural application and can provide a good foundation for implementing off-grid water utilities that can self-sustain its program and end-users demand for vegetative growth, as well as wastewater management.

Conclusion

In conclusion, the diverse precedents explored in this chapter provide valuable insights into Socotra's ecotourism and infrastructural development. The case studies of Palau and the Canary Islands illustrate the environmental and socio-economic pitfalls of unchecked tourism, emphasizing the need for sustainable, low-impact infrastructure that respects Socotra's unique natural landscapes and supports local communities. Architectural precedents like the Friendship Centre, the Women's Opportunity Center, and the Green Planet in Dubai demonstrate scalable and resilient design strategies prioritizing community engagement, educational programming, and environmental stewardship.

[75] Ibid.

The Friendship Centre and Alioune Diop University Unit offer models for educational and research facilities, emphasizing the integration of climate-responsive design, passive cooling, and the use of local materials. These approaches suggest that Socotra's buildings can similarly prioritize low-energy, durable designs that foster learning while conserving resources. Meanwhile, Wadi Hanifa's bioremediation techniques present options for sustainable water management that apply to Socotra's infrastructure needs without compromising ecological integrity.

In essence, each precedent informs a holistic approach to Socotra's development, where ecotourism, education, and community spaces are designed to be both functional and protective of the island's ecological and cultural assets. These case studies provide a practical foundation for integrating responsible tourism, resilient architecture, and off-grid infrastructure that aligns with Socotra's conservation priorities and supports sustainable growth.

Chapter 5: Zoning and the Program

Introduction

With tourism gaining momentum in Socotra, there is an urgent need to consider strategies that safeguard the island's natural integrity while ensuring local autonomy in its development. Unlike typical resort destinations, which often impose external infrastructure that lacks meaningful local engagement, Socotra's tourism strategy must prioritize a model that resonates with the community's values and ecological knowledge. Ethnographic studies underscore that Socotrans and tourists alike want tourism to build on Socotra's rich cultural and ecological identity.[76] However, the implementation of this thesis needs to extend beyond simply improving hospitality standards; this thesis' design will need to reshape tourism frameworks that respect and engage with Socotra's unique environment and its people, rather than allowing the island to fall for overtourism tactics that can risk its nature and culture.

Examining similar contexts, such as the islands of Sal in Cape Verda and Fuerteventura in the Canary Islands, reveals that sustainable tourism can only be achieved through the cohesive integration of locals throughout the development process. The active involvement of Socotrans would shape the infrastructure to better align with the island's ecological and social needs, establishing clear boundaries around which types of activities and proximity levels are appropriate for visitors. As part of this approach, Socotra can focus on establishing a balanced tourism model that

[76] Azan, Layal, and Mohammed M. Gomaa (2023). "A Multi-Stakeholder Approach for Ecotourism and Heritage Conservation in Socotra Island." 355–68.

builds upon the island's existing environmental and cultural assets without straining its delicate ecosystems.

Key strategies this Socotran thesis can adopt include educational programs to raise awareness about conservation practices, the development of eco-friendly accommodations, and infrastructure improvements in waste management and water collection. All architectural and infrastructural advancements should employ sustainable design principles, with an emphasis on ethically sourced materials, thermal comfort, and innovative building systems. This approach not only preserves Socotra's biodiversity, but it also creates a replicable model for sustainable island development. By embedding conservation within the tourism infrastructure itself, Socotra could set a new benchmark for responsible tourism, one that respects local autonomy and enhances scientific knowledge to maintain the island's natural and cultural heritage for future generations.

Program Literature

It is prevalent in current Socotran literature that tourism is the greatest source of income that funds the island on a broad scale, suggesting that its development will witness a great spike in the coming years from multiple investments.[77] However, the current tours held on the island form a distant relationship between those in the tourism industry and residents.[78] It is a similar situation to that on the Cape Verda island of Sal, where all-inclusive stays for tourists rarely engage the two groups with

[77] "UNESCO Promotes Sustainable Tourism and Heritage Conservation in Socotra Archipelago | UNESCO." (2024).
[78] "Socotra Eco-Tours - Tourist Guide on Socotra Specialised in Eco-Tourism." (2024).

one another, forming a clear disconnect between the island's locals and those who wish to visit Socotra for its cultural broadening.[79] Creating a strategic point for tourism in this thesis model will showcase the possibility of having a destination that satisfies both aspects.

However, to bring tourism programs into this development, natural and cultural conservation must be at the forefront of this effort if successful integration is desired. Currently, Socotra's endemic plant species are witnessing a decline in populations due to livestock grazing and other conflicting agricultural practices, as well as the species' populations' naturally slow growth rate in their harsh desert climate.[80] Currently, only 22% of the Dragon Blood Trees' suitable growth locations can be accessible for care due to their locations' drastically sloping landscapes.[81] To offset this effect, this thesis should incorporate or promote conservation methods that alleviate the natural species' population stressors, like avoiding developing on conservation sites, and adding plant nurseries or regenerative fields within the design's program that allow residents and researchers alike to explore the species' capacity and tendencies in optimal growth conditions.

Education and professional development are also much needed in this thesis program, as it aims to connect tourists and locals through a shared interest in exploring the depths of Socotra's nature, heritage, and revenue generation. This should not suggest that residents are not well informed of their land or their specialty

[79] López-Guzmán, Tomás, et. al. "The all-inclusive tourism system in Cape Verde islands: The tourists' perspective." (2016): 9-16.
[80] Miller, Anthony G., et. al. *Flora of the Arabian Peninsula and Socotra.* (1996).
[81] Rezende, Marcelo, et. al. "Identifying Suitable Restoration and Conservation Areas for Dracaena Cinnabari Balf. F. In Socotra, Yemen." (2022): 1276.

services, but to enhance their outreach to visitors and tourists through hospitality service and capacity-building skills that bridge the gap in locally agreed-upon procedures that allow local small businesses to engage more openly with newcomers in cohesive relationships. This component puts an emphasis on natural and business relations, as was developed in the Islands of Palau, and Sal in the Cape Verda Islands, respectively. As the Palauan government witnessed a degradation in their natural landscape, they implemented the Palau Pledge, which highlights tourists' intentions to protect the island for the benefit of their visit and the livelihood of the children on the island.[82] Contrastingly, Sal is currently seeing trends in all-inclusive resorts, tailored towards foreign visitors, that create an "us vs. them" mentality toward locals, where the integration of local business owners and visitor markets should be highly encouraged to avoid resident displacement and inhospitable tourism.[83] This thesis aims to integrate both program aspects, as well as adding shared learning spaces like learning gardens and event spaces, where workshops can be held to merge the two groups together on an equitable platform.

Finally, as this program is designed, the development of sustainable infrastructure is the expectation for the project's overall success, despite Socotra's current low-impact methodology for accommodation and transportation. Socotrans consistently voice their intention to further develop the island in ways that ease the livelihoods of its residents.[84] This thesis must address Socotran wishes and foreign

[82] Medel, Ismael Lopez. "The Palau legacy pledge: A case study of advertising, tourism, and the protection of the environment." (2020).
[83] López-Guzmán, Tomás, et. al. "The all-inclusive tourism system in Cape Verde islands: The tourists' perspective." (2016): 9-16.
[84] "UNESCO Promotes Sustainable Tourism and Heritage Conservation in Socotra Archipelago | UNESCO." (2024).

tourism standards to allow for a model that can act as both a developed destination, while also preserving the ecosystems already in place. This will be in the form of off-grid infrastructure, such as wastewater recycling facilities, water retention ponds, biogas and solar energy conversion, and other strategies. This is to avoid long spans of development throughout the island, and encourage thorough investigation before the implementation of large-scale development like paved roads, electrical lines, etc.

Program Precedent Analysis

Among the five precedents chosen for programmatic and architectural study, the Women's Opportunity Center in Kyonza, Rwanda, stands out as the most aligned with the performance outcomes and programmatic goals outlined in this thesis. This project embodies the collaborative, community-focused approach that this thesis aims to promote. It incorporates all the essential programmatic elements envisioned, but more importantly, it was developed through an ongoing, collaborative process with the end-users, women majority, of this project who would ultimately build and inhabit the center. Their input shaped the training programs and spatial designs, resulting in a facility directly supporting the community's expressed needs.[85]

Throughout construction, Sharon Davis Design remained engaged, conducting regular check-ins, even from abroad, to ensure the project's progress remained faithful to the community's vision. This process fostered a uniquely collaborative approach, blending professional development and community interaction in a way that empowers the women involved. The center also features a market space that

[85] Ibid.

bridges local and visitor experiences, providing visitors with a genuine understanding of local customs and allowing residents to benefit economically and socially from this exchange.[86]

Fig. 5.1 - The Women's Opportunity Center's Photographs and Floor Plan. Source: BrickArchitecture.com. "Women's Opportunity Center / Sharon Davis Design."

[86] Ibid.

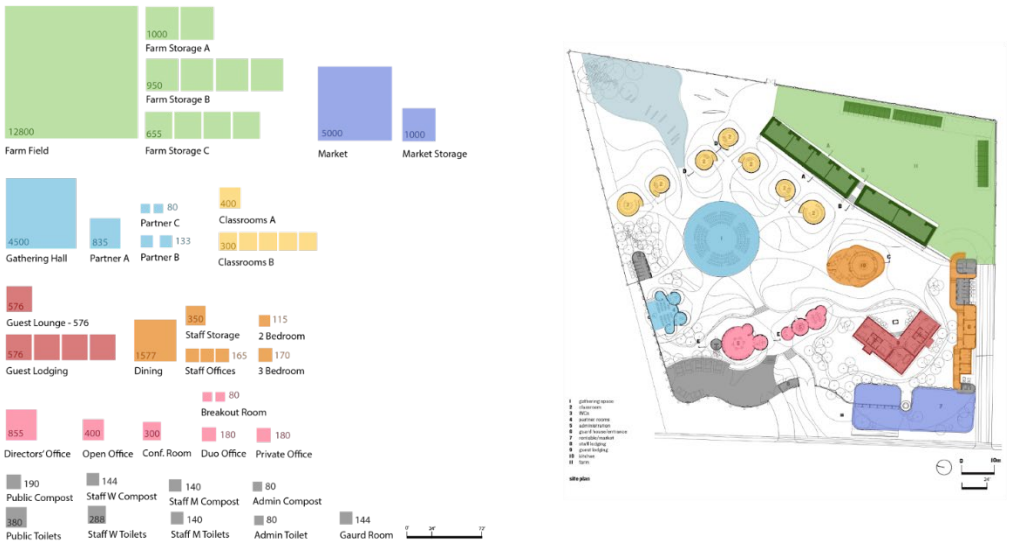

Fig. 5.2 - Women's Opportunity Center Reverse Engineered Program. *Illustrated by author.*

By analyzing and reverse-engineering the Women's Opportunity Center, this thesis draws valuable insights into integrating similar program zones, ranging from education and eco-tourism to sustainable infrastructure. This precedent not only validates the core programmatic zones of the thesis but also informs the ways these spaces can interact dynamically to support the social and ecological fabric of the Socotran community.

Program Conceptualization

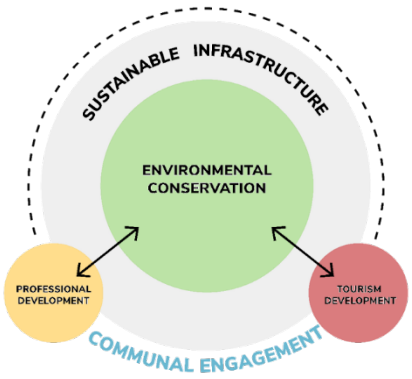

Fig. 5.3 - Conceptual Program Diagram.
Illustrated by author.

Through the investigation of the literature, the following zones emerge with a collaborative relation to one another. The graphic representation of the programmatic zones is centered around Socotra's environmental conservation, which benefits and engages both professional development for the residents, as well as tourism development for visitors. Through this engagement, this program intends to foster communal engagement between various groups, under the larger umbrella of sustainable infrastructure that allows these relationships to blossom.

Program Zones and Tabulation

Professional Development		
Room Name	**Area (SF)**	**QTY**
Higher Education Research Center	5,000	1
Professional Training Center	5,000	1
Lecture Hall	4,000	2
Classroom	900	4
Women's Classroom	700	2
Conference Room	200	3
Children's Interactive Learning G	5,000	1
Market	5,000	1
Total	**25,800**	**15**

Communal Engagement		
Room Name	**Area (SF)**	**QTY**
Outdoor Gathering Hall	4500	1
Community Agricultural Garden	10,000	1
Event Space	4,000	2
Conference Rooms	250	4
Total	**18750**	**8**

Environmental Conservation		
Room Name	**Area (SF)**	**QTY**
Nature Sanctuary Reservation	43,560	3
Plant Nursery	43,560	2
Learning Garden	5,000	4
Plant Sciences Lab	500	8
Plant Growth Simulation Lab	500	3
Total	**93,120**	**20**

Tourism Development		
Room Name	**Area (SF)**	**QTY**
Eco-lodging	20,000	1
Women's Lodging Quarters	5,000	1
Camp Site Reserve	2,400	1
Total	**27,400**	**3**

Sustainable Infrastructure		
Room Name	**Area (SF)**	**QTY**
Water Retention Ponds	43,560	TBD
Wastewater Filtration Plant	43,560	TBD
Biogas Renewable Energy	43,560	TBD
Underground Cistern	43,560	TBD
Total	**174,240**	**TBD**

Fig. 5.4 – Proposed Program Tabulation.
Illustrated by author.

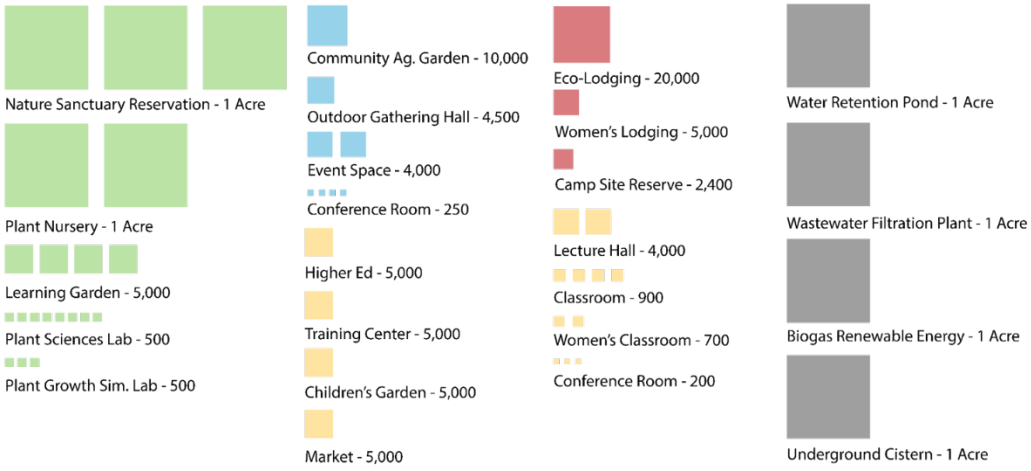

Fig. 5.5 - Proposed Program Scaled Representation.
Illustrated by author.

Environmental Conservation

Environmental conservation is central to this thesis, aiming to not only prevent ecological degradation but also to deepen the connection between Socotrans and their natural heritage. This focus includes the regeneration and sustainable growth of native plant species, which hold immense cultural value and draw eco-tourists to Socotra, supporting the local economy. A key aspect of this program is the establishment of research facilities tailored to Socotra's unique flora, including a growth simulation lab and a plant nursery. These spaces would enable research on-site, addressing the current challenge where researchers must transport seed samples abroad to conduct detailed studies.[87]

By establishing labs equipped to handle the specific needs of Socotra's endemic species, the program enables Socotrans and visiting researchers to explore plant growth and conservation methods directly within the island's ecosystem. The plant nursery would support propagation and regeneration efforts, contributing to the preservation of the island's botanical diversity. Meanwhile, the growth simulation lab would serve as a controlled environment for studying plant behavior under varied conditions, crucial for both conservation and educational purposes.

To ensure these facilities are equipped for effective research, funding will be pursued for specialized equipment and resources. These research hubs could empower Socotrans to lead in the conservation of their land, using scientific insight to

[87] Miller, Anthony G., et. al. Flora of the Arabian Peninsula and Socotra. (1996).

support their traditional knowledge, creating a model of environmental ownership that merges cultural heritage with advanced ecological practices.

Professional Development

The professional development component of this thesis aims to empower Socotrans to communicate their extensive ecological knowledge and cultural heritage effectively, fostering a deeper connection with their environment while engaging with visitors. A key proposal includes establishing a higher education research center on the island, focused on local ecological research and cultural preservation. Currently, Socotrans seeking advanced education in natural sciences often travel abroad, only to return to apply their expertise to Socotra's native species. By creating a dedicated higher education and research facility within Socotra, this program would allow Socotrans to acquire advanced skills at home, reducing the need to leave the island for educational opportunities and enabling them to contribute to local conservation more directly.

Additionally, a training center focusing on intercultural communication could be crucial in creating meaningful exchanges between Socotrans and visitors, encouraging mutual understanding and respect. Such a center would not only enhance locals' ability to share their knowledge with an international audience but would also create a space for visitors to gain greater and more authentic exposure to Socotra’s unique heritage. Investing in these forms of professional development allows Socotrans to cultivate a community equipped to preserve its heritage and ecology sustainably while engaging with the global community on its own terms.

Tourism Development

Eco-tourism is the foundation of this thesis, shaping a tourism model that prioritizes sustainability by balancing local, visitor, and environmental needs. Rather than large hotels or traditional resorts, this thesis' accommodation approach focuses on eco-friendly spaces that are designed to benefit both locals and visitors while preserving Socotra's natural landscape. Among these spaces, eco-lodges stand out as a key program component, drawing inspiration from previously existing accommodations in Socotra but with enhanced design and materials that optimize comfort in the island's climate. These eco-lodges would be more seamlessly integrated into the natural environment, offering a middle ground that caters to typically basic tourism needs without imposing the heavy infrastructure and mechanical systems that can disrupt local ecosystems.

This approach ensures that eco-lodges provide a genuine, immersive experience in Socotra's unique landscape while minimizing environmental impact. By strategically placing these lodges within nature, visitors gain an authentic experience, closer to the ecological and cultural essence of the island, without the intrusive footprint of typical tourism infrastructure. This model respects Socotra's biodiversity and delicate ecosystems, aiming to attract visitors who value conservation and wish to engage responsibly with the environment. By anchoring tourism development in eco-conscious design, this thesis advocates for a tourism experience in Socotra that not only appeals to travelers but also aligns with the values and needs of the local community, creating a sustainable tourism model that preserves Socotra for generations to come.

Communal Engagement

Communal engagement within this program shifts the experience from passive consumption to active and meaningful interaction between locals and visitors. This approach encourages participatory activities that form genuine connections, bridging language and cultural gaps in a collaborative way. By creating shared spaces, such as large-scale gathering areas or interactive learning gardens, Socotrans can take an active role in sharing their heritage, inviting both researchers and leisure travelers to learn from their deep-rooted knowledge of the island's ecology and traditions.

These communal spaces could serve as hubs where Socotran culture is not just observed but engaged with directly, transforming tourism into a more immersive and respectful experience. Learning gardens, for instance, could showcase native plant species and traditional uses, with Socotran guides leading discussions on the island's biodiversity and cultural practices. Meanwhile, gathering spaces could host workshops, storytelling sessions, or cultural demonstrations, creating a shared experience that respects Socotra's unique heritage. This model of tourism values the knowledge and experiences of Socotrans to the visitor experience, redefining what it means to explore Socotra. It becomes greater than a mere visit to a unique natural destination; it becomes part of a dialogue where both visitors and locals contribute to and learn from one another.

Sustainable Infrastructure

Finally, sustainable infrastructure is woven into the programming strategy to ensure the development is able to perform independently, reducing strain on Socotra's existing utilities and water resources, which are already limited in towns and villages

across the island. By integrating self-sustaining infrastructure, this project supports a holistic model that aligns with the island's needs while setting a standard for minimal environmental impact.

Beyond supporting the project's zones, this off-grid infrastructure approach offers a scalable model for smaller villages on the island. By implementing renewable energy sources, efficient water collection and retention systems, and waste management solutions within each designated area, the infrastructure not only serves the immediate needs of eco-tourism but also stands as a potential template for lower-impact development across Socotra. This model considers the reality of Socotra's natural resources, aiming to enhance resilience without compromising existing natural ecosystems.

In advocating for these self-sustaining systems, the project aligns with the principles of resource conservation and community empowerment. By providing a framework that villages of modest means could adopt, this approach highlights how sustainable infrastructure can support long-term development goals for the island.

Chapter 6: Site Selection and Analysis

Introduction

The site for Socotra's ecotourism and social and environmental conservation development will require crucial investigation to provide both desirable and equitable approaches to the development's design. Given the thesis' approach to an environmentally sustainable design model that is inherently equitable for Socotrans and efficient in its energy use, the site must vouch for environmental, social, and economic perspectives. At the project's forefront, the site must be made accessible to residents and manageable by local authorities that engage residents who are active in protecting their social, economic, and environmental ecosystems. With the goals desired, this thesis assumes a site in which the location's overall natural integrity can be preserved. This can be achieved by choosing a site that does not require intensive intervention in its topographic and geological systems.

Additionally, the site must be accessible via common Socotran means of vehicular transportation to be economically feasible when conducting construction and tourist activities. If roads must be paved to ensure the security of such transportation, then the project should either be located in non-preserved zones, in accordance with the Republic of Yemen's Conservation Zoning Plan[88], or, should the paving of roads prove to be essential in conducting beneficial construction attempts, robust evidence must be provided to prove the negligible or compensated impact

[88] "Conservation Zoning Plan of Socotra Islands (Socotra, Samha, Darsa, Abd Al Kuri, and associated small islands rocks and rock outcrops)," 2000.

paving can cause for the selected conservation-adjacent areas. In accordance with Yemen's conservation zoning plan, the development should not occur in designated National Park areas unless official environmental organizations find such zones to be false or overestimated during the due diligence process.[89]

As the thesis program stresses its integration of local-tourist spatial interaction and local professional development regarding environmental conservation and tourism development, the site is preferred to be accessible to both Socotrans and tourists, and must connect to prominent nature reserves and regeneration plots. This could potentially lead to a variety of site options; An exclusively rural destination, within accessible routes from urban tourist populations and near suitable Dragon Blood Trees' regeneration zones; an exclusively urban destination, within a walkable distance from Socotran residents with humble means and no access to vehicles; or a split site selection, where different programs can interact with different rural or urban settings or be remotely directed towards the two settings based on programmatic and professional requirements. To enhance the site's qualities for tourism and education pursuits alike, it is preferred to be easily accessible to culturally significant landmarks, such as the Firmihin Forest, Socotra's most prominent Dragon Blood Tree concentration; Hoq Cave, the host of wide varieties of ancient archeological evidence of past Socotran inhabitants; or one of Socotra's most prominent shorelines, including Delisha and Arher Beaches Northeast of Socotra, or Detwah Lagoon Northwest of Socotra.

[89] Ibid.

Socotra Comprehensive Analysis

To introduce the reasoning behind the site selection criteria, one must consider Socotra's relationships between its geographical and geological systems. This identification will aid in creating the selection criteria in accordance with this thesis' chosen program.

The main driver in Socotra's site determination is its monsoon seasons, given that they are the most influential factor in the sustenance of Socotra's built environment and human health conditions. Socotra, as stated in the [*Literature Review*] chapter, experiences two monsoon seasons annually, which are recorded and analyzed through its 11 weather stations located throughout the island. The Northeast monsoon, which occurs from September to March, but mainly during the Winter months of January to February, typically consists of light cloud coverage and rainfall, with average temperatures peaking at 86*F and dropping to 66*F. The average windspeed during this time is around 5-15mph, causing minimal interruptions to everyday life on the island. The Winter season is also when most of Socotra's endemic flora species begin to bloom, including the Desert Rose. Conversely, the Southeast monsoon, mainly occurring throughout the summer months of June-August, is vastly destructive due to its extreme rainfall, which results in ongoing flooding upon coastal regions and water sources, and its severe dry spells that create near uninhabitable living conditions for Socotrans. The average temperatures during this monsoon peak at 90*F and fall to 73*F, and its average windspeed can reach

Socotra's highest estimates of 30 or more mph, which can prove harsh in Socotra-exposed landscapes and humble building envelopes.[90]

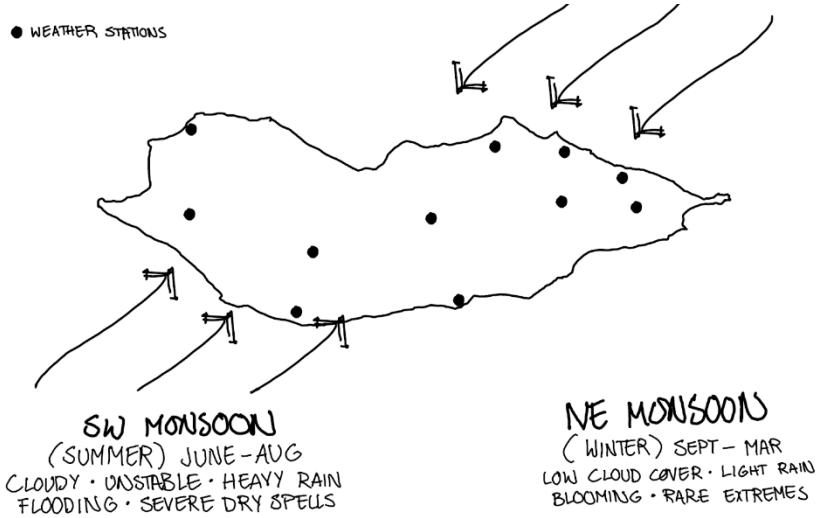

Fig. 6.1 - SW and NE Monsoon Seasons of Socotra.
Illustrated by author.

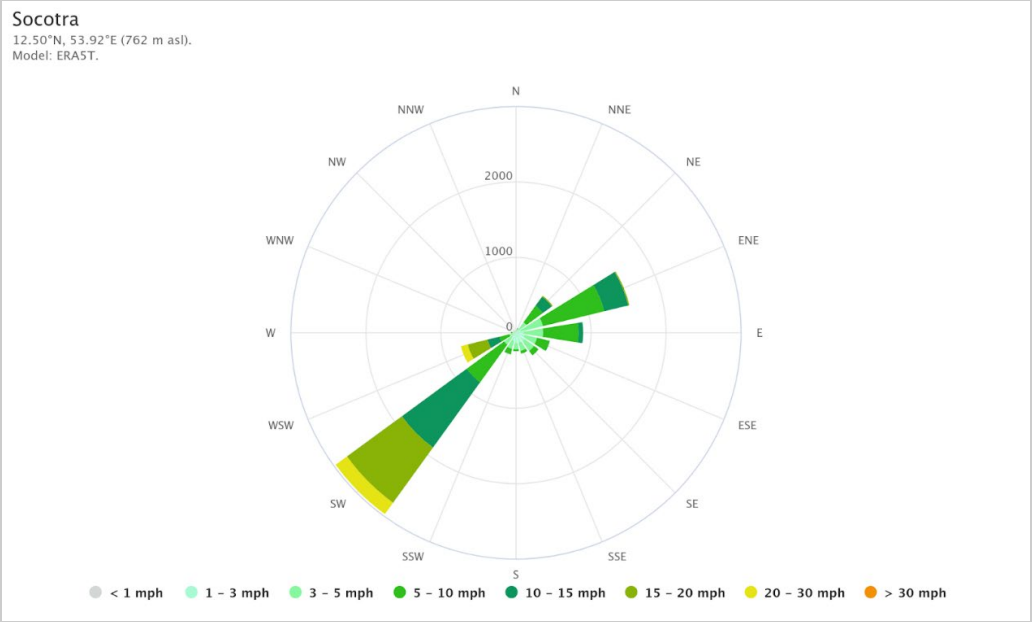

Fig. 6.2 - Wind Rose of Socotra.
Illustrated by author.

[90] meteoblue. "Weather Hadibu."

Amplifying Socotra's monsoon impacts are the island's extreme topographic landscapes, in which its highest sea level elevation is 935mi.[91] The island's geology is mostly made up of rocky granite mountains, limestone plateaus, and coral and limestone sandy coasts.[92] The central mountain locations tend to increase the rate of rainwater runoff, and intervention throughout the island's main watershed, which can prove very difficult for Socotrans living on the island year-round. However, towns and villages located within limestone plateaus are better protected by harsh winds and rainfall effects of the SW monsoon, due to their shielded locations nestled among granite and limestone cliffsides.[93] Therefore, the protected areas illustrated below will be optimal for a development that aims to protect end-users from harsh environmental conditions and implement building interventions that maximize thermal and living comfort.

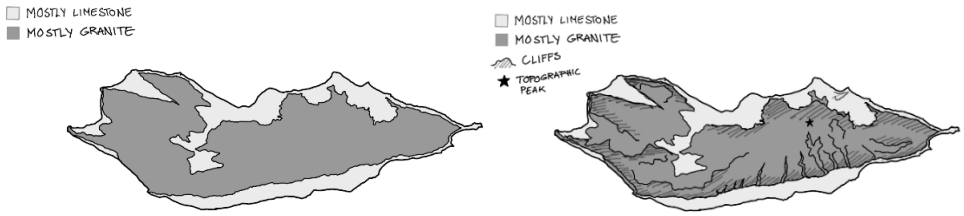

Fig. 6.3-4 - Geological Characteristics of Socotra.
Illustrated by the author.

[91] Esri. "World Topographic Map," 2024.
[92] Van Rensburg, Julian Jansen. "Part Three: The Maritime Landscape and Climate," 2016.
[93] Bradt, Hilary, and Janice Booth. *Socotra: The Bradt Travel Guide*. 2020.

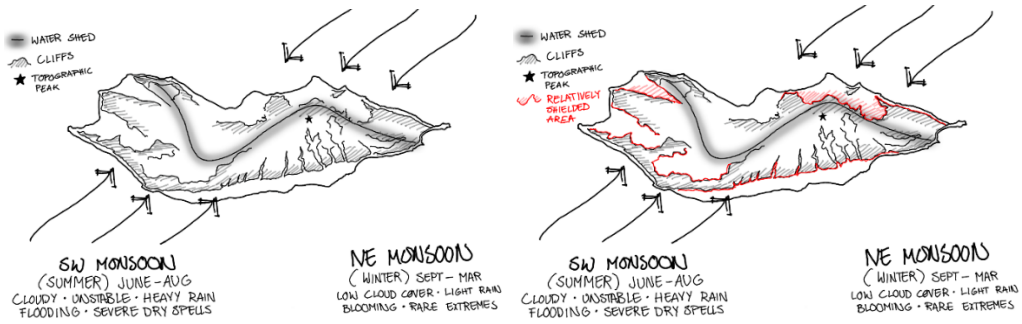

Fig. 6.5-6 - Comprehensive Cliff Analysis of Socotra & SW Monsoon shielded areas. *Illustrated by the author.*

As a final geographical factor of choosing specific site selection criteria, Socotra's conservation Zoning Plan needs to be considered to determine buildable locations and locations in which natural and cultural artifacts should not be built on or around. There are four levels to Socotra's zoning plan: 1. General Use, 2. Resource Use Reserve, 3. National Park, and 4. Nature Sanctuary. General use, the most minimal zone on the island, allows any type of development, as long as it is in accordance with Socotra's overall conservation and development regulations. This includes tourism development, as well as industrial construction. Resource Use Reserve zoning allows for most built development, except for industrial or large-scale agricultural developments that can deplete the land from its natural resources. National parks limit development to minimal essential buildings, such as the development of medical facilities for rural villages. Finally, Nature Sanctuary designations limit any development, and reserve the land for research and education observation purposes only.[94]

[94] "Conservation Zoning Plan of Socotra Islands (Socotra, Samha, Darsa, Abd Al Kuri, and associated small islands rocks and rock outcrops)," 2000.

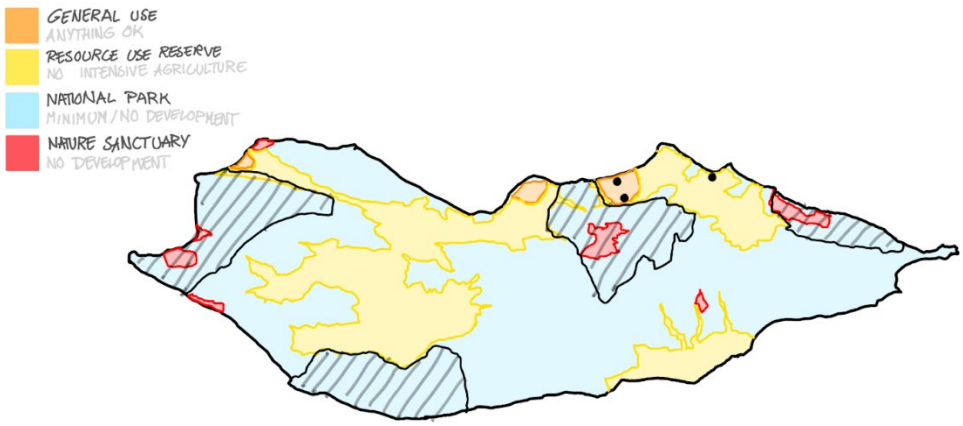

Fig. 6.7 - Socotra Zoning Plan - Three refined site locations NE of Socotra.
Illustrated by the author.

These conditions have shaped the selection criteria grouped below. It is a series of layering of the multiple illustrations already referenced in order to narrow down the site into smaller, more focused sites based on both the programmatic needs, as well as the geographical constraints found in the region.

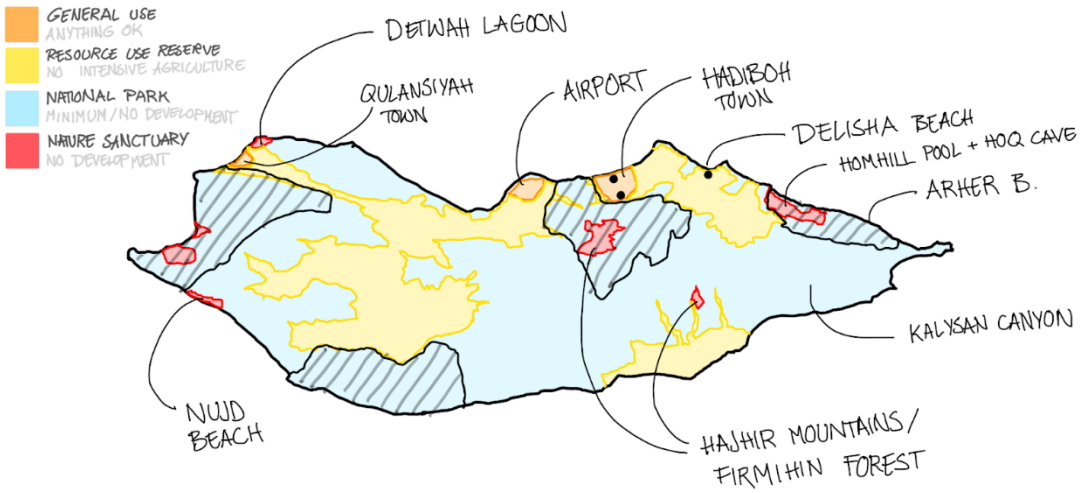

Fig. 6.8 - Socotra Zoning Plan – All major destinations.
Illustrated by the author.

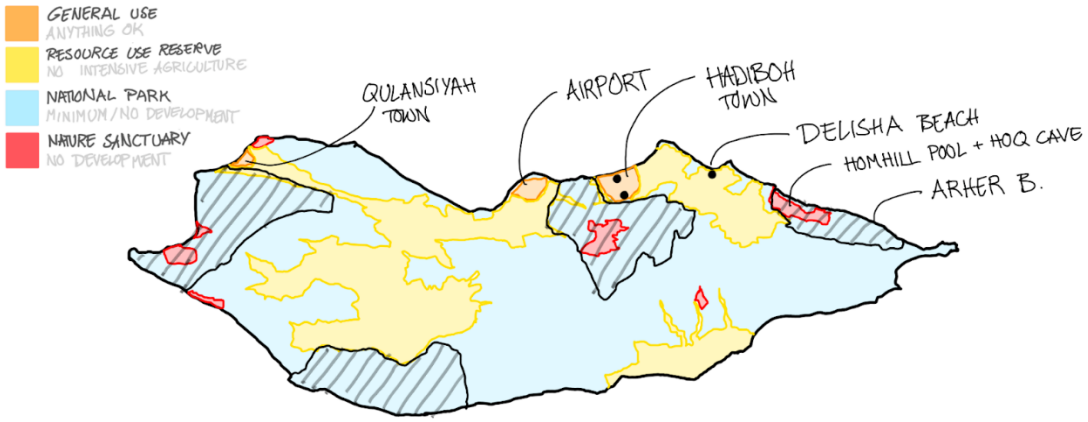

Fig. 6.9 - Socotra Zoning Plan - Major destinations within SW Monsoon shielded areas. *Illustrated by the author.*

Site Selection Criteria

The following criteria are ordered in levels of importance, where criteria #1 is most important to the thesis' programmatic and geographic requirements.

1. Easily Accessible to Socotran towns or villages - through vehicular transportation
2. Easily Accessible to Tourist destinations – through vehicular transportation
3. Approximately 5 miles away from zones of Natural Conservation and Regenerative Potential Zones – To enable environmental conservation programs but avoid environmental contamination.
4. SW monsoon-shielded area – To mitigate natural disaster-prone development.
5. Approximately 5 miles away from Existing Infrastructure – Including one or all of: paved roads, telecom service, water sources, electrical lines, etc.
6. Approximately 5 miles away from naturally or culturally significant destinations

From the referenced contextual information and selection criteria, the following sites are chosen and evaluated based on their most suitable traits for climate and thesis narrative potential:

- *Agricultural Village, South of Hadiboh, Socotra, Yemen*
- *Delisha Beach Coastline, Eerk, Socotra, Yemen*
- *Capital Town of Hadiboh, Socotra, Yemen*

Adunawah Agricultural Village, South of Hadiboh, Socotra, Yemen

12°37'38.2"N 54°02'02.7"E
General Use

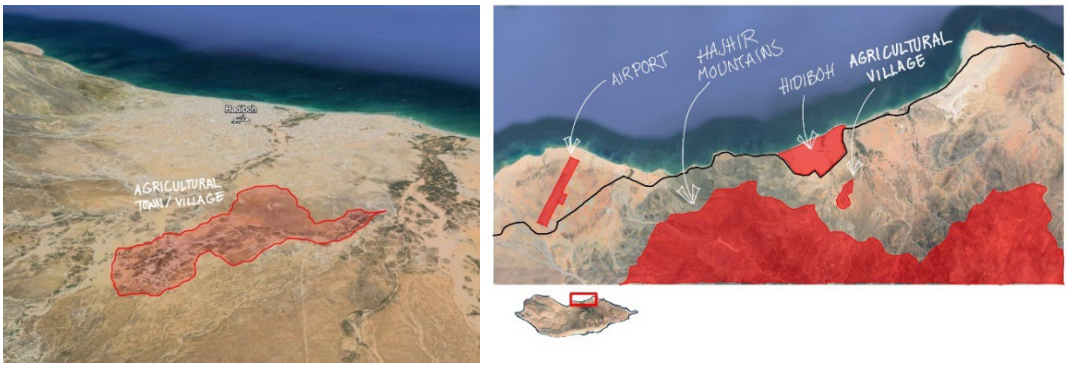

Fig. 6.10-11 - Agricultural Village Orientation and Adjacency.
Illustrated by the author.

Note: The Adunawah agricultural Village is the chosen site from the following analyses. This selection is due to the variety of uses it provides the thesis design, in accordance with its landmark and natural affordances. Its most suitable traits, compared to other selected sites, are tailored towards the thesis program's intention of appealing to Locals and Tourism Development, and enabling the possibility of environmental conservation and sustainable infrastructure. In addition to the thesis program, the agricultural village is also most suitable for Socotra's climatic and geological conditions, as will be provided in depth below.

The Agricultural Adunawah Village is a village 1.77 miles South of Hadiboh, the capital town of Socotra. Its existing agricultural and building development surrounds a stream that frequents the area due to rainwater runoff cavities that run from the top of Socotra's Hajhir Mountains, at the center of the island, to Hadiboh's Bashir lagoon at the island's northern coast. It is within the major limestone plateau surface of the island that is split from the island's overall granite mountains. The village's major

access point is through an off-road that directly connects to Socotra's central paved road, offering a relatively direct path to and from the island's airport. Its proximal major destinations include Hadiboh and Delisha Beach (NE, 8.88 mi).[95]

The site's most important quality, and the main drive for its selection as the thesis site, is its proximity to the capital town of Socotra and other neighboring villages. This is directly related to the thesis' success, as the program aims to connect local Socotrans to professional and environmental development. The site's location to Socotra's highest population allows for a varied approach to experiencing the development. In contrast to existing development programs in Hadiboh, however, this site allows for the environmental demonstration that Hadiboh sites cannot offer due to the relatively high urban modality of the capital.[96]

The village is also 100ft above sea level, with the closest shoreline being that of Hadiboh's coast, around 2 mi from the village's center. The existing agricultural development is cupped by the Hajhir Mountains throughout its Western and Southeastern bounds, with access to the Adourna walking trail that leads directly towards the Hajhir Mountains' peak, Firmihin Forest, and Diksam Plateau.[97] This site's adjacency to the island's most elevated locations at its Southwestern side shields it from the extreme impacts of Socotra's Southwest monsoon, and its inland location from the island's shoreline also protects it from the potential flooding experienced from the Northeast monsoon. In addition to shielding the site from harsh weather patterns, the neighboring peaks connect the site to rainwater streams

[95] Google Earth Pro. "12°37'38.2"N 54°02'02.7"E," 2024.
[96] Bradt, Hilary, and Janice Booth. *Socotra: The Bradt Travel Guide*. 2020.
[97] Ibid.

collected from the Hajhir mountains. The site also neighbors' water and electrical infrastructure to its Northeast,[98] which appears to serve all of Hadiboh's satellite villages nearby. This will be beneficial in enhancing the thesis development's infrastructural development, by allowing the thesis to explore more advanced systems that can serve off-grid communities, beyond the basic implementation of island-coordinated infrastructural systems.

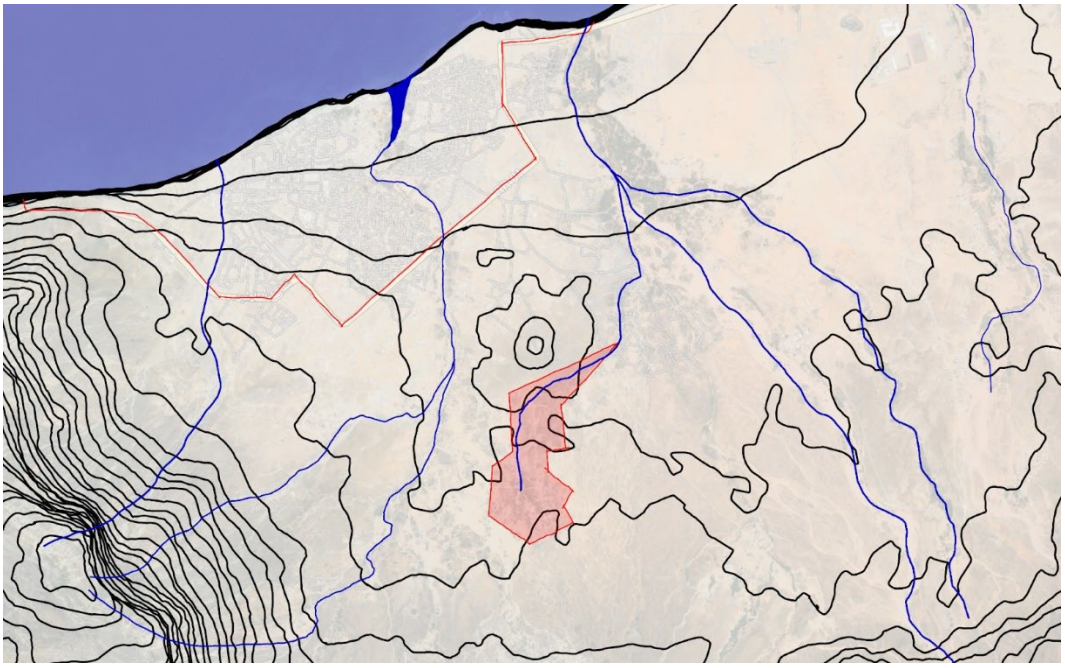

Fig. 6.12 - Agricultural Village Topography and Water Flow.
Illustrated by the author.

Due to the site's access to multiple water sources and evident agricultural density surrounding the water stream cavity, the soil is highly fertile, enabling environmental regeneration efforts. The agricultural village also poses its buildability potential as a moderate location, being that it is in a fertile, relatively flat location, made up mostly of limestone deposits. This buildability is most appealing when

[98] Google Earth Pro. "12°37'38.2"N 54°02'02.7"E," 2024.

compared to Hadiboh's highly industrial environment and Delisha Beach's sandy shorelines. [99]

Generally, in accordance with the site matrix's rating system, the Agricultural Village scores highest in addressing the thesis goals and challenges, enabling the environmental and social connections required to enhance the final design. With further analysis of the site-specific locations within the Agricultural Village's bounds, more qualities and site-specifics will be analyzed.

Fig. 6.13-14 - Agricultural Village Landmark and Water Infrastructure Adjacency. *Illustrated by the author.*

[99] Van Rensburg, Julian Jansen. "Part Three: The Maritime Landscape and Climate," 2016.

Delisha Beach Coastline, Eerk, Socotra, Yemen

12°40'01.8"N 54°09'22.7"E
Resource Reserve Use

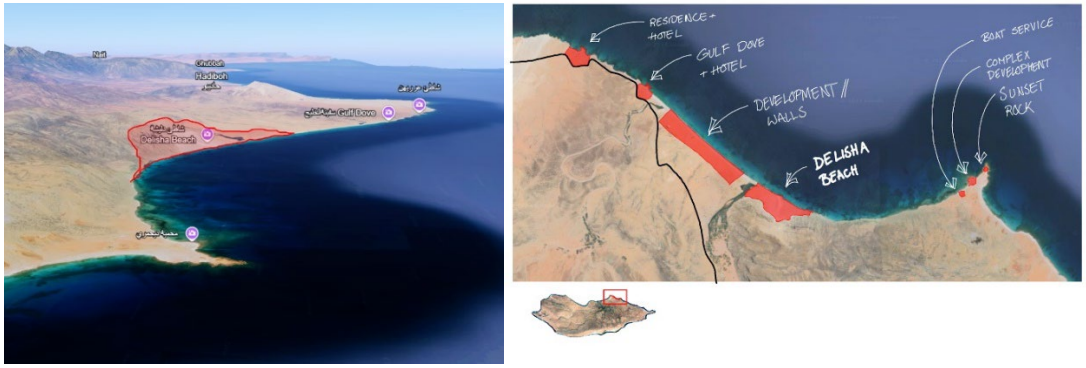

Fig. 6.15-16 - Delisha Beach Orientation and Adjacency.
Illustrated by the author.

Delisha Beach, located along Socotra's airport road's Northeast side, is one of Socotra's most famous tourist beaches, due to its feature of a single white sand dune that is centralized along Delisha's coast. The Delisha coastline contains multiple nodes that vary in development uses, including residences, tourist accommodations, fishing services, and other natural tourist attractions, as can be seen in the following diagrammatic analyses. Along the Socotran airport road, Delisha is also highly accessible to other natural and historic landmarks of the island, including Hoq Cave, Arher Beach, and Ras Malik Northeast/East of the island.[100]

Although the site's nodal adjacency prompts great potential for the thesis' tourism development and locals' relative adjacency, the site's climatic resiliency and environmental conservation are limited. Delisha Beach's coastal location and gentle slope southwest of Socotra make the location highly prone to northeast monsoon

[100] Google Earth Pro. "12°40'01.8"N 54°09'22.7"E," 2024.

floods and southwest gusts and floods, creating a high risk for the site's feasibility. Additionally, the beach's sandy surface creates a major difficulty in not only building developments with minimal site impacts[101] but also creates an additional issue to environmental regeneration potential. Environmental conservation strategies will require off-site or remote handling, which negates the overall objective of the thesis on environmental development.

[101] Van Rensburg, Julian Jansen. "Part Three: The Maritime Landscape and Climate," 2016.

Fig. 6.17-22 - Delisha Beach Nodes and Infrastructure Adjacency.
Illustrated by the author.

Capital Town of Hadiboh, Socotra, Yemen

12°39'00.3"N 54°01'05.7"E
General Use

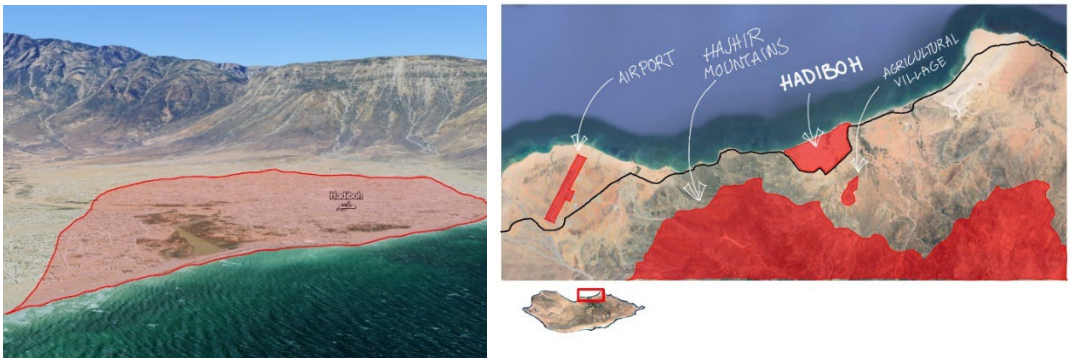

Fig. 6.23-24 - Hadiboh Orientation and Adjacency.
Illustrated by the author.

Hadiboh, the capital town of Socotra and the initial site considered for this thesis, is the most populated location on the island. It is the closest large-scale development to the airport, and it is usually the first destination migrants and tourists experience upon their landing on Socotra. Its population was recorded to be 10,000 in 2020, but it is acknowledged to have grown exponentially with greater worldwide knowledge of Socotra. The capital's connection to the island's central paved road allows it to be the epicenter for both locals and tourists in search of accommodations, services, education, and more.[102]

Overall, it is a city that is developed along a main commercial street, one that branches off the island's central road, with various anchors that pivot the street system and create finer block clusters. Commerce, education, infrastructure, and residential uses are all weaved throughout one another, with commutes not exceeding

[102] Bradt, Hilary, and Janice Booth. *Socotra: The Bradt Travel Guide*. 2020.

15 minutes from Hadiboh's West and East boundaries.[103] The capital town's bustling environment is also enhanced by its diverse soil allocation, which varies from rigid limestone at the urban center to softer fertile soil near Hadiboh's lagoon. However, the thesis development cannot create equitable interventions at this location due to its relatively highly developed nature compared to other parts of the island. The transportation and creation of off-grid infrastructure, large-scale environmental conservation and regeneration, and appeal to tourism development cannot be sustained in this heavily urbanized environment. Moreover, there is a wide variety of educational centers and tourist accommodations that already serve the island, creating a large disparity between Hadiboh and other sites on the island that are in need of such interventions.[104]

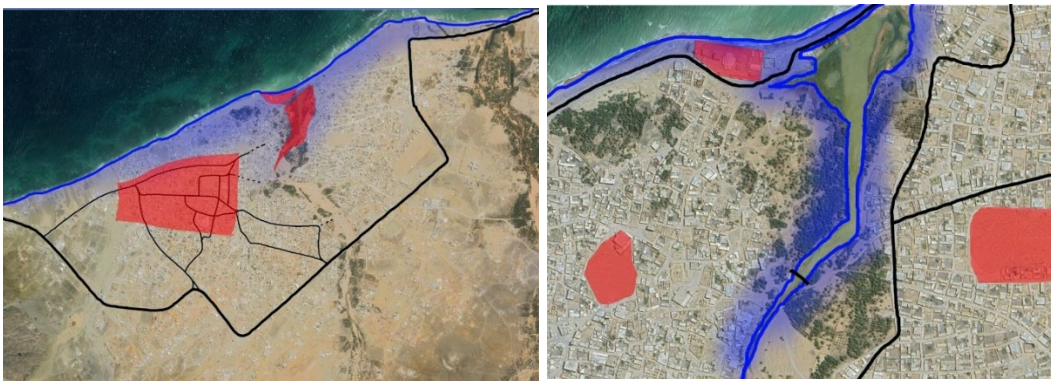

Fig. 6.25- 26 - Hadiboh Landmark and Water Infrastructure Adjacency.
Illustrated by the author.

[103] Google Earth Pro. "12°39'00.3"N 54°01'05.7"E," 2024.
[104] Ibid.

Chapter 7: Discovery Phase

Introduction

Prior to elaborating on the pre-schematic approaches proposed in this chapter, it is important to establish what is and is not understood about Socotran architecture and heritage, and how what is unknown can be compensated for with other working topics, and how known aspects of Socotran architecture or heritage can be incorporated in the selected site. Understanding the available information and how such information was developed also works in favor of the formal narrative and direction this thesis will explore and advance as the design is finalized.

Architectural Precedents and Socotran Lessons

As was discussed in the [*Precedents*] Chapter, multiple case studies were chosen and, in turn, helped inform the programmatic needs of the thesis design. From the intangible lessons gathered from the Palau Pledge in Palau, Oceania; the environmental metaphors developed in the Friendship Center in Bangladesh; the infrastructural processes explored in Wadi Hanifa Wetlands in Saudi Arabia; the technical building envelope teachings of Alioune DIOP's University unit in Senegal; to the comprehensive relationship of all of these aspects and their programmatic relationship to one another in the Women's Opportunity Center in Rwanda, all of these precedents have helped shape the thesis into what it could be on a conceptual and theoretical realm.

However, when beginning the design of Socotra's sustainable development, it would be a great injustice to neglect the lessons provided on the island in terms of architecture and lifestyle alike. Despite this crucial aspect, although Socotra's natural, social, and historical background is greatly documented in public literature, the architectural imagery is very scarce, and found architectural landmarks' locations are rarely cited. After speaking with a visiting architect in Socotra, it was revealed that the reasoning behind Socotra's scarce architectural reference is largely due to the island not having much built development nor population densities to require or establish a formal architectural language on the island. Moreover, most communities on the island do not exceed populations that justify labeling them as villages, or hamlets, let alone cities, which further explains why the architectural process, and especially its documentation and publication, is very limited.

Fig. 7.1 – One of the Limited Documented Mosques in Socotra; Unidentified Location. *Source: Primordialoperadora. Instagram.*

Instead, the architecture on Socotra, even for prominent buildings such as mosques and community leader residences, is dependent on the respective communities and landowners to explore their own desires for the style and function of each building. Most common buildings that include residences or small essential stores are made of site-specific materials, with community-specific construction processes, where the design is merely based on functionality, and the envelope is constructed based on materials and knowledge that is readily available. While the community-specific processes are being explored with further interviews with architects, it is also worth noting the island's well recorded heritage and natural assets that can build just as strong of a foundation for a design thesis as constructed evidence would.

Socotra's Heritage and International Influence

As was discussed in the [*Literature Review*] Chapter, and visualized in the diagram timeline below, Socotra has been in contact with an extensive range of populations and ancient civilizations that have shaped the island's standpoint in its geographical position as well as helped situate how the thesis can begin to delve into its deep and meaningful history. Through its early encounters with Arabian, Indian, and Greek kingdoms' settlements, as well as its Maharah Sultanate's governmental strife with Portuguese and British colonialism, Socotra and its people have developed a strong sense of self-governance and a desire to exclusively self-govern their own land. Regardless of the leadership of the island, Socotra maintained its reputation as master contributor to the Frankincense Trade and most knowledge to maximize its Natural assets, including its most iconographic natural organism, the Dragon Blood Tree. This

is extracted from multiple examples, including Socotra's earliest recorded documentation, in both written and cartographic collections, has regarded the island with either Frankincense or Vegetative expertise. This reputation, although not as commonly known in modern literature, but extensive in its botanical research studies conducted on the land, continues to dominate the narrative of the island.

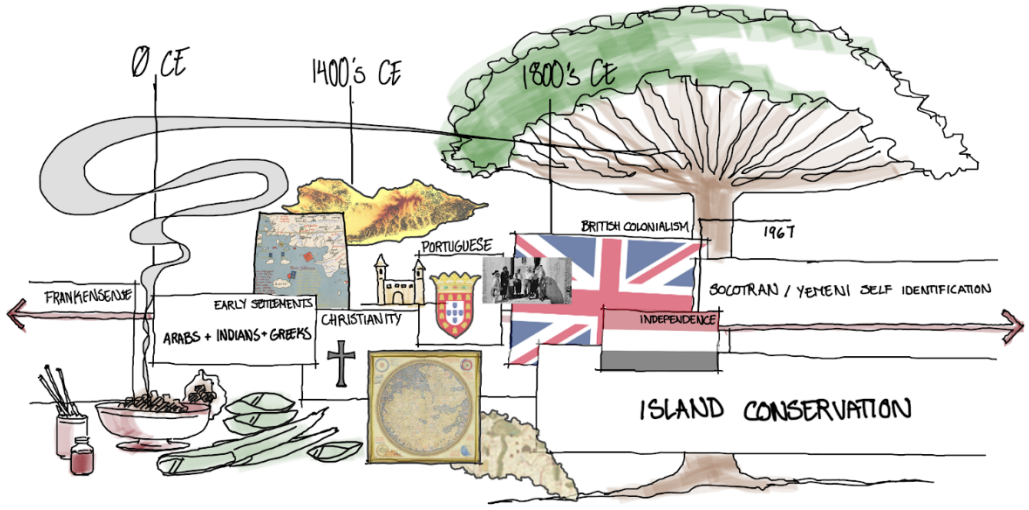

Fig. 7.2. – Conceptual Timeline Representing Socotra's Heritage and Settlements. *Illustrated by author.*

Socotra's Natural Processes

The reputation that dominates Socotra's natural narrative is not merely an iconographic one aimed at marketing strategies to welcome tourists to the island, although it definitely works in the island's tourism's favor. This narrative, especially that given to Socotra's plant life is given due to the vegetation's consistent dominance

over Socotra's landscape, as opposed to the island's built development. The island's harshest environmental conditions, which have succeeded in toppling man-made developments in countless occasions, have fell short when going against the island's vegetation. This is largely due to the vegetation's strong evolution, such as that of the Dragon Blood Tree, that has allowed it to maximize their living and growth conditions to maintain their presence on the island.

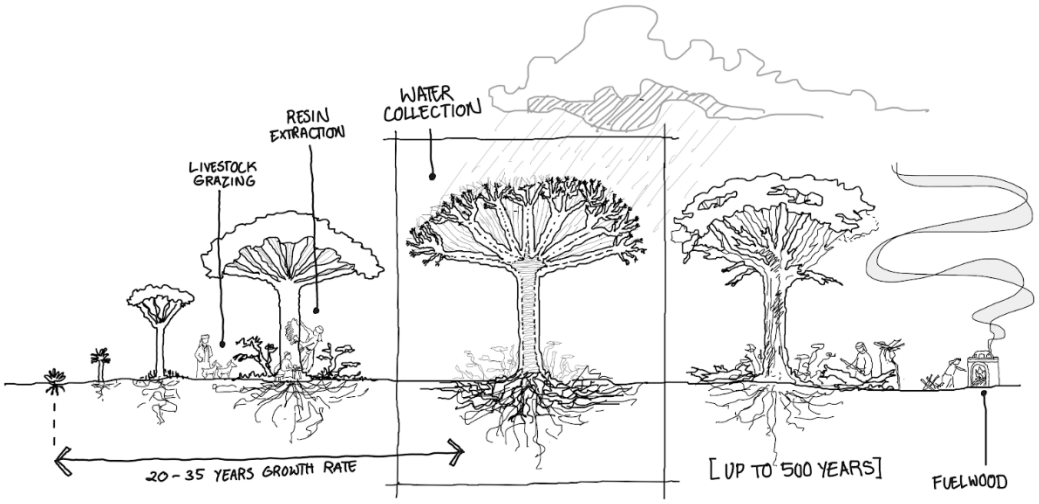

Fig. 7.3. – The Dragon Blood Tree's Lifespan Stages and their Benefits. *Illustrated by author.*

The Dragon Blood Tree has been Socotra's most iconic symbol given that the tree is one of the most efficient organisms on the island, which positions it strategically as a great source of inspiration for how sustainable development on the island can become a *living* manifestation of the tree's lessons. Aside from its stable growth and population rate on the island, the Dragon Blood serves as a broad nurse plant to itself and other plant species, and an asset to Socotran traditional lifestyles

alike. For its own safeguarding, the tree has evolved to form a spongy trunk that maximizes water storage within its interior, as opposed to regular rigid trunk systems found in typical trees. This spongy interior is then enclosed with an internal layer of a maroon colored sap (hence the tree's name), and an external-most layer of thick bark. When the tree's bark is injured or disfigured in any location within the trunk or secondary branches, the sap is quick to harden and create a protective shield around the Dragon Blood's spongy trunk against the island's harsh desert climate. This strategic protective shield has great potential in setting a precedent for Socotra's thesis design of a protective masterplan and building skin that acts similarly to a Dragon Blood's Sap.

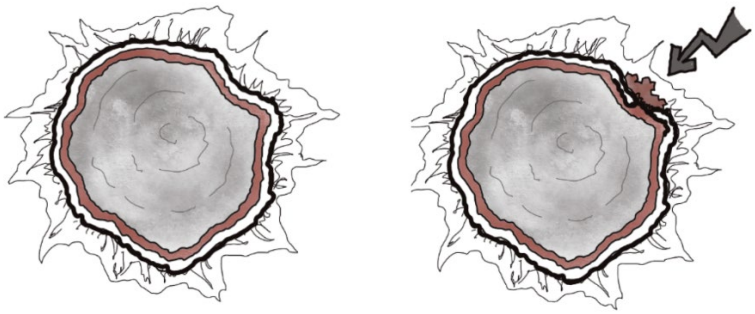

Fig. 7.4. – Plan of the Dragon Blood Tree's Spongy Trunk. *Illustrated by author.*

Beyond its self-induced benefits, some of its external benefits can prove problematic for its population if taken on a commercial scale, such as commercial sap/resin extraction, livestock grazing, and fuelwood collection, when these functions are maintained through traditional scales, the tree can serve as a hub for social and natural closed-system benefits. The Dragon Blood Tree's water collection and retention is also worth noting, as its spongy interior has helped it not only maximize the water capture of rainfall and moisture within the mostly arid climate conditions of

Socotra, but its additional shallow root system have established ways in which the tree can act as a nursing plant for smaller types of Socotran vegetation that can be protected and grown underneath its wide and dense canopy. The tree's intricate relationship to water use and capture, along with other water resources established by Socotrans, like streams, creeks, traditional wells, and rainwater cisterns, have all been traditionally cared for to maintain Socotran private and community gardens that help natives and wildlife sustain their living beyond their dependence on external shipments into the island. This sustainability and close-system relation is crucial to inspiring the design of the thesis development to encompass similar self-sufficient systems that can manifest in building design or programmatic relationships.

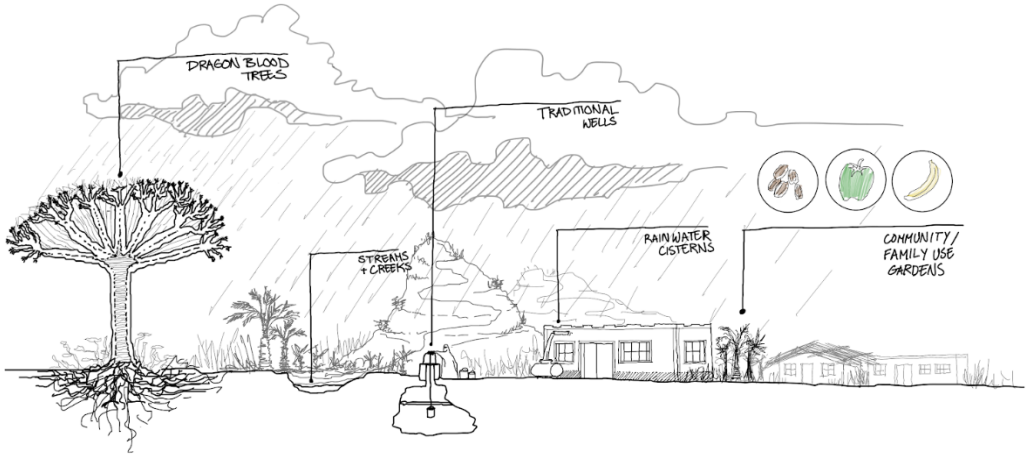

Fig. 7.5. – Water Collection Strategies throughout Socotra. *Illustrated by author.*

Adunawah Village and the Thesis Objective

After establishing the framework already extracted from local traditions and lifestyle processes, Adunawah Village can be tested through pre-schematic design. It is still important to note some brief qualities of the site, independent of those already

compared on a wider scale to other larger areas throughout Socotra in the [*Site Analysis*] Chapter.

Literal Site Analysis

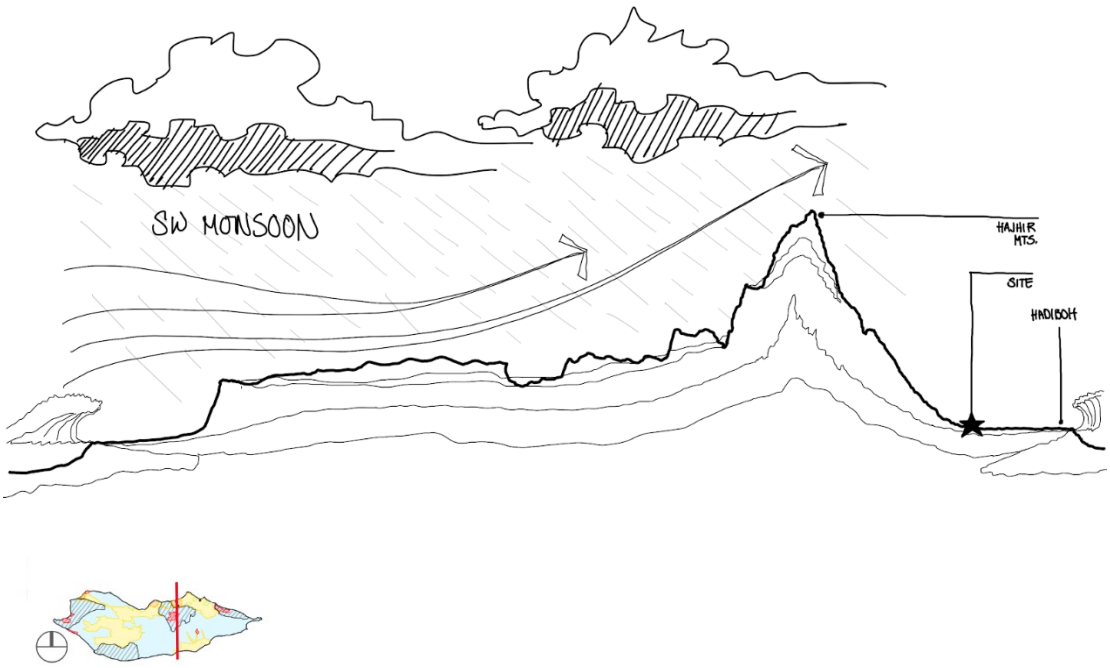

Fig. 7.6. – Section of the island of Socotra showcasing Geological Conditions.

Illustrated by author.

Upon viewing a section through the entirety of Socotra, the importance of Adunawah's position at the benches of the Hajihir Mountains becomes apparent due to its inland location far from the Hadiboh coastline and safe from potential coastal flooding, and due to its protection from the Southwest Monsoon's greatest wind impacts.

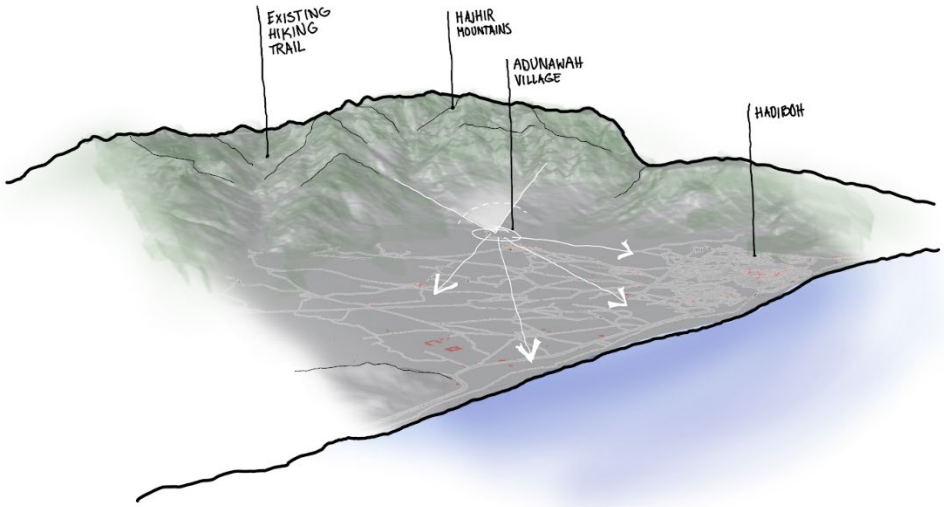

Fig. 7.7. – Aerial View of Adunawah in relation to Hajhir Mountains and Hadiboh. *Illustrated by author.*

Additionally, using a more realistic 3D view of the village's position, this relationship to the Hajihir Mountains, as well as Hadiboh, is emphasized. The Village, although on the outskirts of the capital town, is still only around 2 miles away from the center of the capital town, and 2.5 miles away from the coast of Hadiboh. The driving distance, in particular, is around 9 minutes from the center of Hadiboh. This position offers the thesis design feasible access to Socotra's most significant urban density while also connecting it as close as possible to one of the most prominent natural sites, the peaks of Socotra's mountains that connect to trails that lead to Firmihin Forest, Socotra's greatest Dragon Blood Tree landmark.

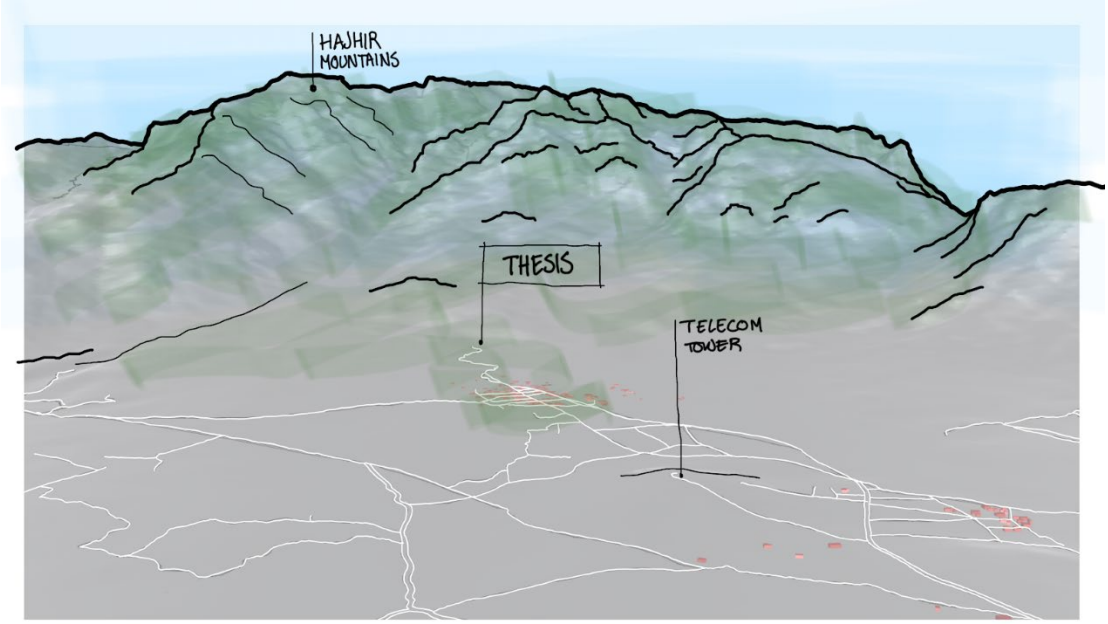

Fig. 7.8. – Close Up Aerial View of Adunawah. *Illustrated by author.*

Through a closer lens of the 3D view, a mound at the edge of Adunawah is called out, due to its inclusion of a telecom tower with other infrastructural power facilities that can be observed through aerial imagery. More investigation is required to confirm the extent of these power supplies, but their presence within the selected site are prime indicators for potential of off-grid or grid-positive benefits that the thesis development can explore to sustainably generate energy, as well as feed the island's cross-community power grid.

Figurative Site Analysis

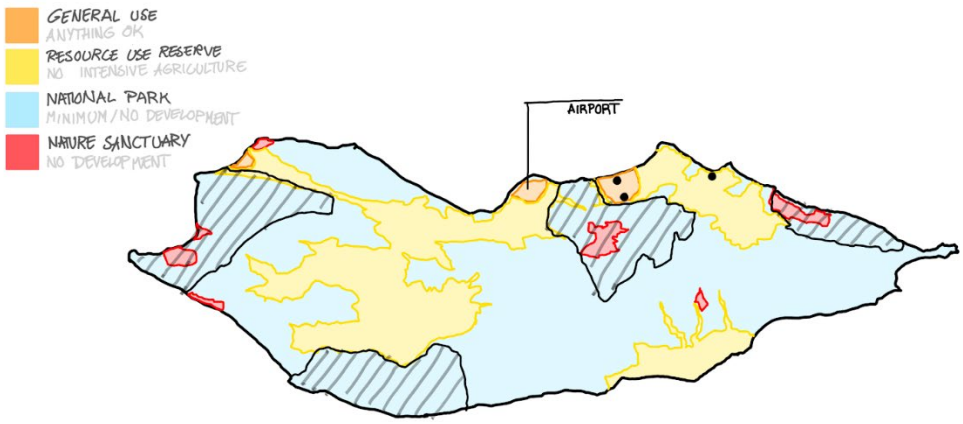

Fig. 7.9. – Conservation Zoning Plan of Socotra, developed in 2000 by the Republic of Yemen. *Illustrated by author.*

On a more conceptual take for the thesis' potential design, Adunawah also benefits the development in terms of its figurative position and viewpoints. Adunawah currently stands at the edge of Socotra's existing Conservation Zoning Plan's General Use Zone at the eastern-most General Use designation on the island. Directly South of this zoning ordinance is Socotra's expansive National Parks system, with the Hajhir Mountains especially being called out for being of natural significance, and the Firmihin Forest particularly being a Nature Sanctuary. There is also a central road that extends the entirety of the North-South length of the Adunawah community, which cuts off into an occasional stream path and hiking trail up to the Hajhir Mountains. This zoning and pathway distinction can form great metaphorical implications for the design of the thesis, as the development can become a transitory experience between what is man-made and urban, as a result of likely urban sprawl as

the island population increases, versus what is natural and protected, in the form of strictly zoned nature reserves.

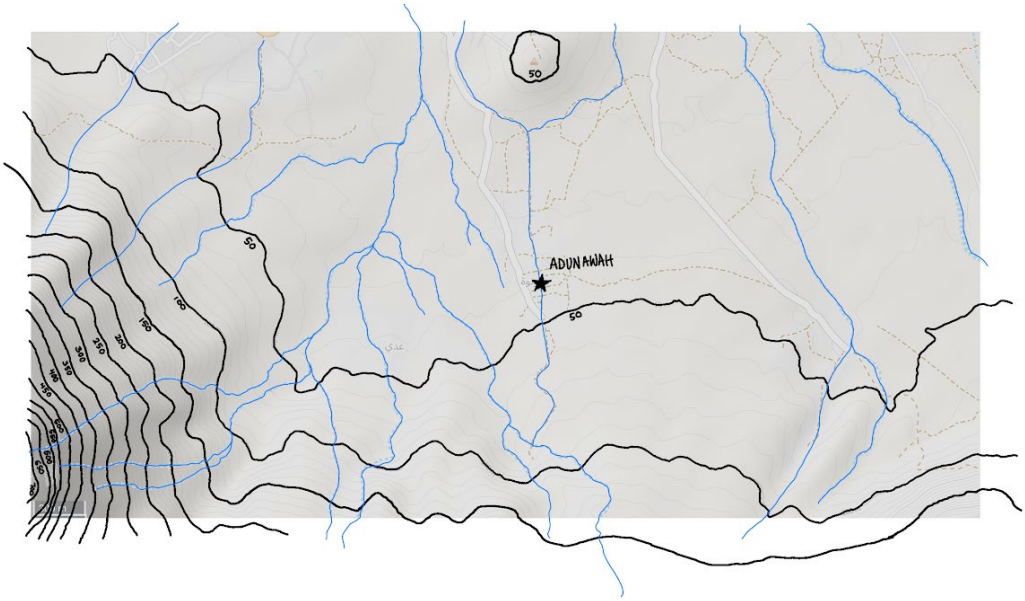

Fig. 7.10. – Adunawah Terrain and Rainwater Runoff. *Illustrated by author.*

Finally, at the conclusion of the specific site analysis, the position of Adunawah at the base of the Hajhir Mountains is further reflected in its dramatic terrain that is exponentially dense along the Southwestern and Southern surroundings of the village. The dramatic terrain at the southernmost end of the village, directly facing the central road along Adunawah, introduces a direct view to Hadiboh's coastline when angled around 10* Northwest of the central road's axis. This relationship can offer the potential for overviewing the island's urban town, marketing the thesis development towards not only tourists, but to broaden researchers of native and international descent on the relationships between the main towns of the island with their neighboring villages.

Fig. 7.11. – Viewport from Adunawah towards the coastline of Hadiboh.

Conceptual Exploration

Given these potential prompts within the greater site and its relationships, the following pre-schematic designs offer multiple ways in which the Adunawah's zoning, pathways, and viewports, can be interpreted to create various forms of development on the site. A relative scale at which to compare all schemes can be that the built forms are generally all around 60,000SF in area, which can derive from multiple programmatic needs and compromises.

Pre-Schematic Design 1 – Threshold

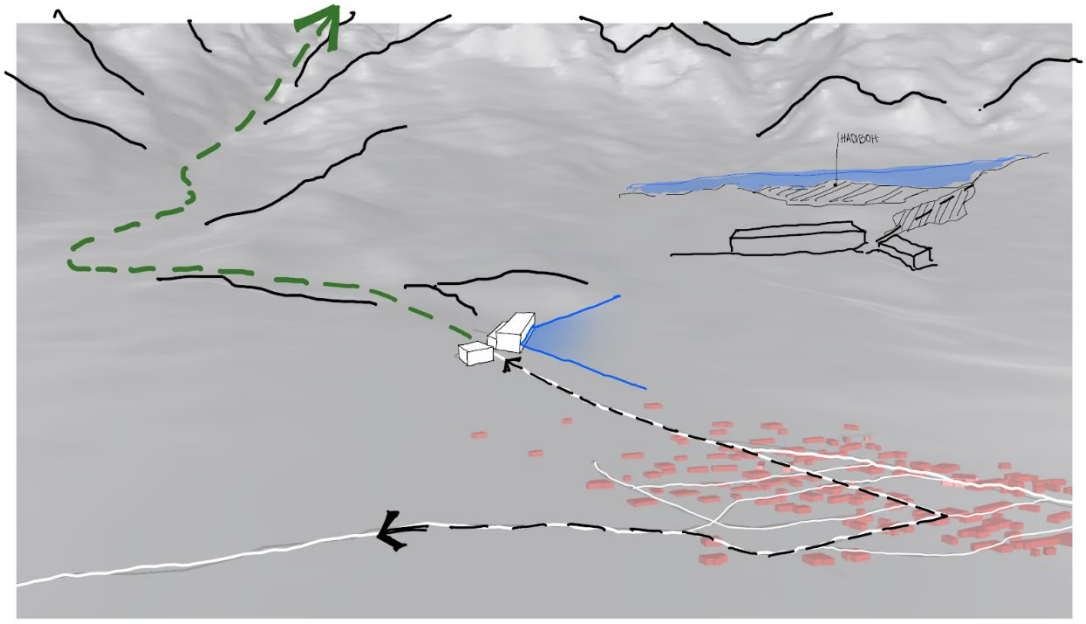

Fig. 7.12 – Pre-Schematic Design 1 – Threshold. *Illustrated by author.*

The Threshold scheme, which creates somewhat of a bottleneck effect when both the central road of Adunawah and the Hajihir Hiking Trail meet, is one that encourages and invites visitors of the development to seek beyond their views going into the Hajhir encounter. While one edge of the threshold can be on a smaller scale, the angled length of the larger edge can be more grandeur, with higher elevations and floors, to allow for a clearer viewport towards Hadiboh's coastline. Smaller offset massings at the Southern sides of both edges are to be conceptualized as exit ways that lead up to walking landscape trails into the Hajhirs.

Pre-Schematic Design 2 – Gateway/Node

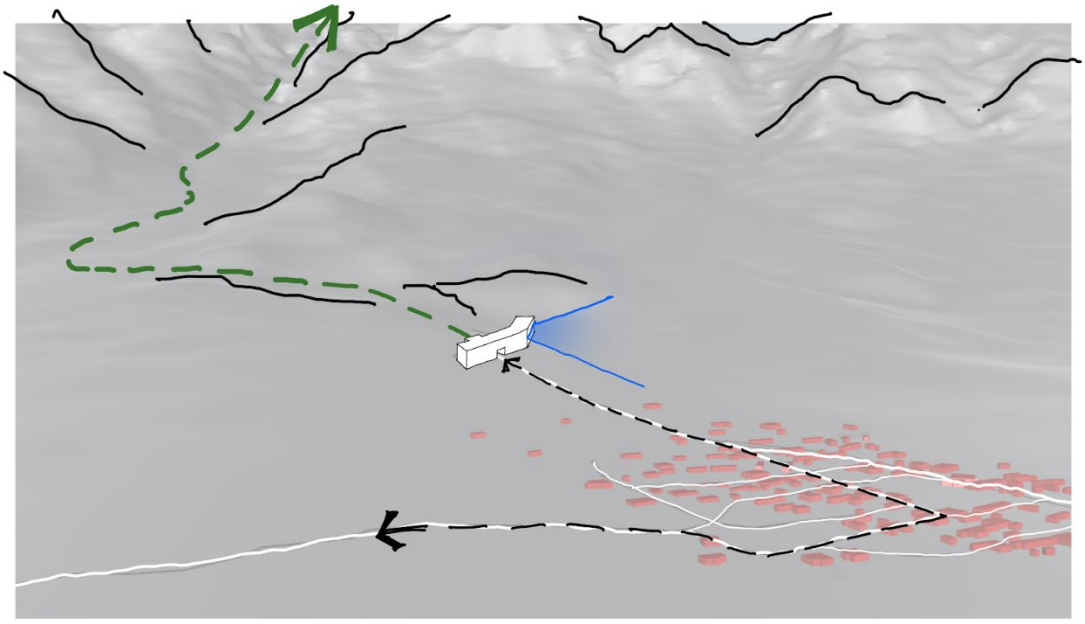

Fig. 7.13 – Pre-Schematic Design 2 – Gateway/Node. *Illustrated by author.*

Unique to the other schemes, the Gateway/Node does not split the built massings between the central road of Adunawah and the trail, and instead is built on top of the intersection to force visitors to enter the built development and experience what it has to offer. This can be a strategic scheme to understand which programs can work to be that welcoming point of the entire development. Whether tourist or professional development programs are met at first glance, versus botanical education and research programs, is still to be determined. The same angle is

maintained at the western end of the built form to allow for the same viewport to Hadiboh's coast.

Pre-Schematic Design 3 – Corridor

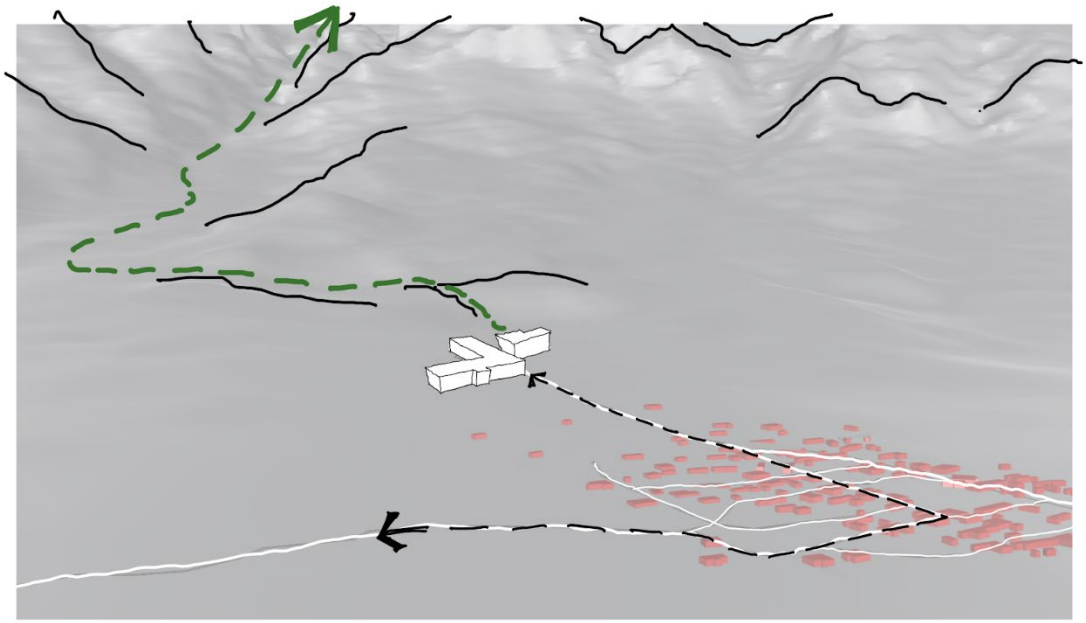

Fig. 7.14 – Pre-Schematic Design 3 – Corridor. *Illustrated by author.*

Finally, the Corridor scheme is generally one that maintains Socotran traditional building forms, and invites itself to be broken down into multiple orthogonal massings that can meet the scale of existing buildings in Adunawah, which then line throughout Adunawah's central road. Although an angle is not explicitly stated in the formality of the scheme, the L-shape can accomplish similar views via the East-West length of the Western form.

Chapter 8: Extended Discovery and Design Solution

Introduction – Extended Discovery

Following the Spring semester of advanced design research and iterative design, the design solution's foundations have evolved significantly from what they were prior to the beginning of the design semester. Therefore, a series of subtopics within this chapter will build upon, as well as justify, the transition from the research documented prior to this chapter, and the design solution that was presented as part of this thesis's academic conclusion. Precedents, Program, and Site Analysis will all be re-explored during the following subtopics, but they will be combined with larger topics that have influenced the design of both the masterplan and individual building typologies that exist in the design solution.

To answer the thesis question, How can the application of sustainable architecture in Socotra, Yemen, set a model for ecotourism that preserves ecologies, meets user needs, & promotes local autonomy? Taking Root presents *Ma'noufah's Center for Socotran Botanical Heritage*, Adunawah Village's Dragon Blood Tree regeneration nursery & research center. It proposes a strategic and organizational model for natural and cultural preservation throughout Socotra and other developing destinations in the Middle East. This thesis's design solution expands to be a part of a greater eco-tourism initiative that aims to improve the livelihood of the development surrounding communities and support cultural and knowledge exchange between locals and visitors. The initiative sets out to involve the greater population that runs

the community where the development takes place, exploring vernacular ideals when conducting new architectural standards.

Fig. 8.1. – Adunawah Village; Existing Site Plan. *Illustrated by author.*

Thesis Terms of Critical Analysis

At the initiation of the design iteration, four key terms from the thesis question were explored and critically analyzed to establish a working ground for the scope of the thesis design. This is also to understand what that can imply for impacted communities as they pertain to eco-tourist initiatives. Such terms are *sustainable architecture*, *eco-tourism*, *ecologies*, and *local autonomy*. Although their following subsections might briefly mention components of the design solution, the architectural exploration will be detailed in another section.

Local Autonomy

Socotran communities are characterized by close-knit family structures with shared responsibilities in farming, household chores, and craftsmanship. Their daily routines are shaped by weather, land access, and communal values. The design reflects this by supporting communal gathering areas, gardens, and outdoor kitchens. It does not interrupt existing habits but offers upgraded spaces for what already exists in their lifestyle. The people of Socotra regard their environment as an integral part of their identity. They grow food near their homes, use local trees for shade and medicine, and respect natural features along their paths and in their settlements. The design lets the landscape guide the placement of buildings, pathways, and farming plots. It builds with the land instead of on top of it.

Development that does not include the people of Socotra often fails or is not maintained. Past modern efforts have ignored local builders and farmers' techniques. Instead, Taking Root was created by first learning from those who live there and their habits. The lessons learned helped shape everything from the market space to the

plant nursery, ensuring they support existing roles, especially for women and farmers. Throughout this project, Socotran expertise was used to inform decisions on layout, construction, and operations. This includes how walls are constructed, which paths were used for walking, and how land is managed. Their knowledge guided both low- and high-impact choices. This ensures the design will remain effective in the long term and continue to be useful to the community.

Eco-Tourism

Eco-tourism attracts individuals who seek to experience unique landscapes and cultures in a manner that is respectful and minimally impactful. In Socotra's case, this means visitors are drawn to its unique plants, natural views, and cultural traditions. This Ma'noufah project uses that interest to support local income without harming the island's land or people. Many eco-tourism efforts still benefit outsiders more than locals. They can create unsustainable population densities, damage the natural landscape, and increase prices that affect locals' livelihoods. These are real concerns, and this project plans to avoid them by ensuring that locals lead the planning and benefit from the results.

To avoid typical issues, this project integrates eco-tourism into the community it is embedded within, making it part of everyday life. The markets, farms, and houses are designed for locals first, but also offer tourists opportunities to participate in small, guided ways. The goal is to grow local income and keep control in the community's hands. Instead of building new resorts or tourist hubs that only serve tourists, this design enhances lifestyles and spatial designs that already benefit locals.

It improves farming, crafts, and education—activities that tourists can also participate in. This keeps the focus on the people who live there, not just those who visit.

Ecologies

Socotrans use their land for food, healing, and shelter. Their daily life depends on how well they care for it. The design supports this by keeping farming close, placing water features where they naturally occur, and allowing paths to follow the land contours. Everything is designed to work together as a single system. Rather than treating buildings, plants, and people as separate entities, the design creates space where they intersect. Shaded porches, outdoor walkways, and farming zones around homes help link life indoors and outdoors, and each of those spaces is utilized in different positions within the overall

Sustainable Architecture

Many outside solutions fail to mesh within heavily vernacular destinations like Socotra. They are too expensive or do not align with people's lifestyles. This design does not force new systems; instead, it works with what people already do. It respects their methods while helping them improve where needed. Socotran builders use their body and surroundings to measure, cut, and place materials. They build what they know works. This project maintains that approach but adds support where needed—such as improved insulation or safer retaining walls—so it remains useful and safe. The buildings use stone, mud brick, and gabion walls, just like many Socotran homes. But they also use newer techniques where needed, like burying rooms for cooling.

Adunawah Village's Extended Site Analysis

Extensive research was conducted specifically at the southernmost portion of Adunawah. This area is reflected within the full boundaries of the Existing Site Plan above. As will be explored in the following subsections, ethnographic and formal research established the formal outcome that is presented in this thesis design.

Ma'noufah Area and the Ma'noufah Women's Organization

Despite being a relatively small village in terms of built density, Adunawah Village hosts a variety of groups and organizations that conduct relatively larger-scale operations due to the village's agricultural density. The whole village is patched with multi-scale agricultural plots, from small house-yards to medium neighborhood produce gardens, to large date palm farms. The majority of community gardens, located within the Ma'noufah area in Adunawah's larger village, are maintained by a group of around 100 women. The Ma'noufah women have established their own informal organization in which they allow tourists from Hadiboh to tour their gardens, as well as purchase their handmade clay pots that they sell for revenue generation in order to maintain their landscape. The understanding of the demographics and groups that operate within the village can better help inform the design solution on what program needs to be included or compromised from the initial ideation in order to justify the aspects of cohesive eco-tourist development.

Formal Analysis of Adunawah's Built and Natural Landscape

The formal analysis of Adunawah's building orientation, geometry, and density greatly influenced the massing ideation of this thesis' design solution. This is

especially true given that little information is available to understand exactly what Adunawah looks like on-site. Instead, general imagery of Socotran villages and limited news articles were used to better understand the spatial qualities of the spaces viewed from Adunawah's aerial site imagery. This process of referencing was also used to generate conceptual views looking both into the site boundaries and out to the surrounding landscapes.

Fig. 8.2-3. – Adunawah Village; Conceptual Site Views. *Illustrated by author.*

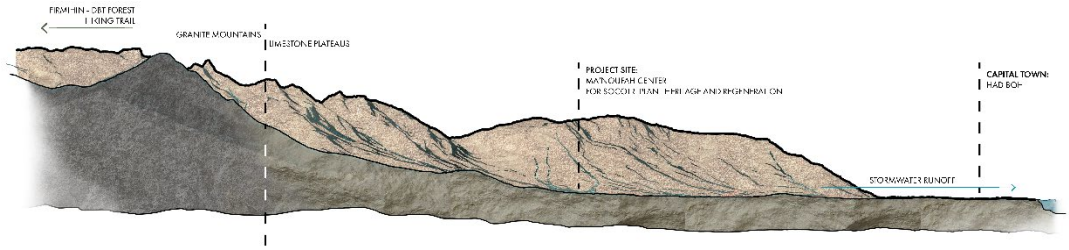

Fig. 8.4. – Geological Makeup of Land in Relation to the Project Site. *Illustrated by author.*

Additionally, the topographic orientation of the village's existing buildings inspired the design solution's approach to the existing land terrain around the site plan. This was particularly true for the two buildings within the Site Plan that completely strayed away from the typical parallel nature of standard buildings to the contours. Such buildings were then concluded to be mosques directly aligned towards Mecca, positioned 40 ° west of True North. This angular shift established yet another site-organizing principle, laying the foundation for the design solution's master planning and overall concept.

Fig. 8.5. – Adunawah Village; Existing Site Plan with Mosques Highlighted. *Illustrated by author.*

Stormwater Runoff and Flooded Conditions

Finally, although Adunawah might be protected from the Southwest monsoon's most significant impacts, given that it is located directly beneath Socotra's highest peak of the Hajihir Mountains, it falls vulnerable to large volumes of stormwater runoff whenever the Southwest Monsoon storms wash against the Hajhirs. Fortunately, Adunawah only receives one concentrated stream of water from such runoff, and it is a relatively gentler stream that branches off from a larger, more impactful stream that runs Southwest of Adunawah's greater boundaries, heading Northwest.

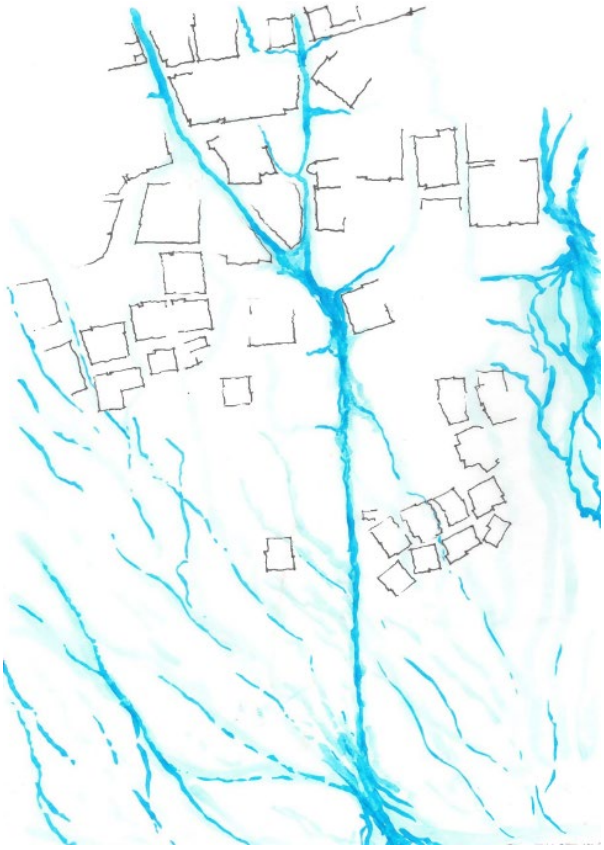

Fig. 8.6. – Adunawah Village; Existing Flooded Condition. *Illustrated by author.*

Architectural Application of Socotran Villages

Although few formal Socotran precedents exist, making this project a proposed architectural model that can be applied for Socotra will still require construction methods similar to what is typical on the island. Because it's a majority of villages and hamlets, it is best to understand how the construction of these villages is conducted. A lot of it is controlled by the trade skills of the respective builders of the village, therefore not many construction aspects can be imposed within the design, however most of it is a feasible estimation of what can be done. The following imagery is representative of the typical architectural features present in Socotra's settlements.

Fig. 8.7-8. – Socotran Village Imagery. Source: Figueroa. "Everything You Must Know About Traveling To Socotra." & Axelrod. "A precarious living on the Yemeni island of Socotra."

Presented Design Solution

Fig. 8.9. – Ma'noufah's Center for Socotran Botanical Heritage; Aerial View. *Illustrated by author.*

Taking Root, the entirety of this thesis, is a process of design that aims to bridge cultural heritage with economic generation in a sustainable tourism strategy that builds on the community and site in which it is located. It offers a design solution to a site-specific problem – in this case, the regeneration of Dragon Blood Trees where their natural regeneration is vulnerable – in a feasible, controlled environment where local Socotrans are prioritized and engaged throughout the conceptualization and development of the design.

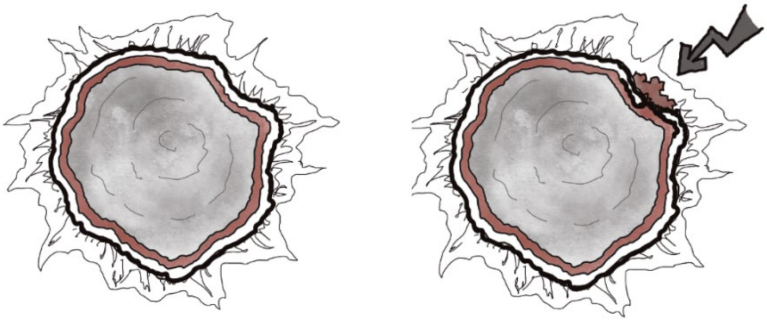

Fig. 8.10. – Plan of the Dragon Blood Tree's Spongy Trunk. *Illustrated by author.*

This is achieved by a simple parti that encapsulates both the process and design outcome – A figurative interpretation of the Dragon Blood Tree's defense

mechanism, where the most vulnerable qualities of the design, similar to that of the tree's spongy trunk, are initially protected by a rigid exterior, such as that of its rigid bark, and an adaptive barrier that protects and defends the interior if any intrusion is made, like its hardening resin.

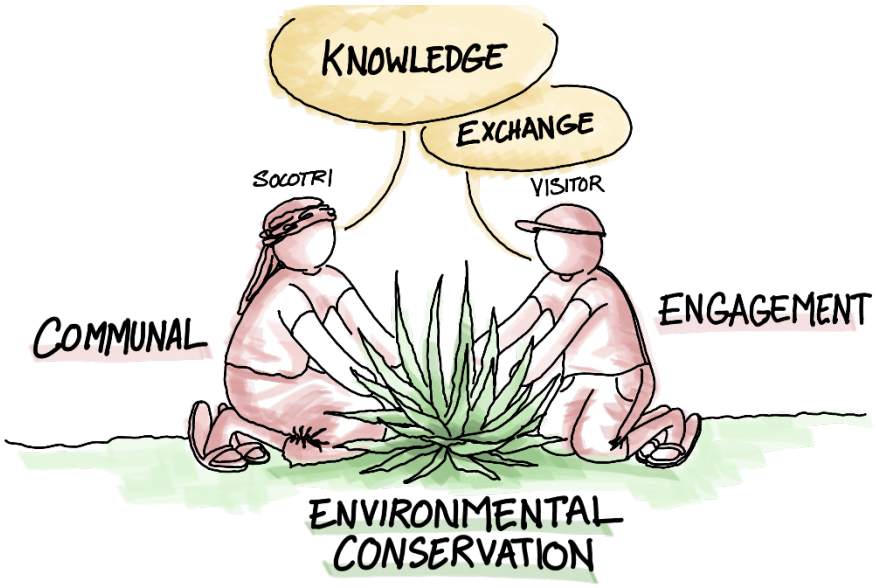

Fig. 8.11. – Illustrated Program Initiative. *Illustrated by author.*

The thesis and program initiatives both set out to emphasize this defense mechanism by setting ground rules in which such intervention is justly evaluated based on the locals' and site landscape's needs. At its foundation, the program is an approach towards *Environmental Conservation* in Socotra, where the natural heritage of Socotrans is prioritized towards their cultural view on preservation and conservation. This is manifested in an architectural research center that initiates the development of this site, where Socotris, Mainland Yemenis, and resident researchers from other countries can collect, store, and simulate the growth of the Dragon Blood Tree seedlings. A particular program to note within this center is its temperature-

controlled seed chambers, that would be burrowed below grade to maintain the interior temperature that bypasses Socotra's monsoon seasonal shifts.

The core initiative of the program, *Communal Engagement*, aims to tackle the relationship between Socotris and visitors, including resident researchers from abroad, tourists, and other parties. It does so in participatory and integrative interactions that avoid any dominant governing hierarchy, where all groups are able to initiate projects, while still prioritizing Socotri's needs in the smaller Ma'noufah community. This is found in multiple points of the development, but is concentrated mainly within the marketplace program that establishes a new workspace for the Ma'noufah Women's Orgnaization, including not only administrative services for their growing entrepreneurial initiatives, but also functional indoor/outdoor studios for their significant clay-making, textile-weaving, and other craftsmanship trades. This program, although public-facing with the marketplace, where both residents and tourists can contribute to Ma'noufah's economic generation, still hosts private, shielded quarters for the women to partake in outdoor activities without the pressure of being exposed to male counterparts. In addition to the marketplace, communal engagement is also concentrated within the housing neighborhoods that are reserved for employee ownership and intended as the primary method of hosting tourists within the village. This is largely to avoid displacement efforts to the overall village and prevent large-scale resort or hotel accommodation developments within Adunawah.

The ultimate expected outcome of such communal engagement is *Knowledge or Cultural Exchange*, where both parties can build on one another's teachings to

ultimately benefit the community and environmental gain of the development project. This is also intended to decentralize the hierarchy of theoretical approaches of environmental reform from external scientific knowledge, which has the tendency to overpower feasible and tested vernacular teachings from cultural knowledge, that have greater chances of implementation due to their years of successful application. By emphasizing the narrative of an exchange, both groups can work together to build on their knowledge simultaneously to sustainably benefit their combined goals of environmental and developmental growth. This is most essential to the collaborative skills and trade development center, which hosts multiple academic and entrepreneurial spaces, in addition to two labs that can be utilized by apprenticeship and higher education programs.

Local Expertise – Site Organization and Massing Development

[Responding to the Local Autonomy.]

The site is composed entirely of public-facing buildings with no enclosures or fencing, such as the marketplace. The farm and Dragon Blood Tree nursery, where more vulnerable trees are cultivated, are defined by gabion and fieldstone walls—both high and low—that deter livestock. In areas where livestock may attempt to jump over, plots are further protected by thorny vegetation that discourages intrusion, particularly by goats. The research center, housing the most vulnerable growth stage of the Dragon Blood Tree, is embedded below grade to ensure maximum protection within the overall development.

Fig. 8.12. – Site Plan of the Ma'noufah Center. *Illustrated by author.*

Fig. 8.13. – Plan of the Ma'noufah Center. *Illustrated by author.*

The site was selected specifically for its lack of existing structures, avoiding the need for demolition or major alterations. The building scales are drawn from the surrounding village, referencing both public buildings such as the main mosque and

private residential forms. Two key axes organize the development: a north–south axis anchored by the marketplace, which symbolically connects the village to the Hajhir Mountains' hiking trail, creating a dialogue between built and natural landscapes; and an east–west axis aligned with Mecca, locating the research center as a reflection of the scholarly and spiritual functions traditionally associated with madrasas and mosques.

Hydrological conditions also shaped the layout. An intermittent stream crosses the site, and while no building intersects this watercourse, a system of bridge dams and terraces in the southern plots slows monsoon runoff, channeling it into controlled irrigation paths that support agricultural zones.

Unlike the structured forms elsewhere on site, the Dragon Blood Tree plots are irregular in layout, following the natural topography to optimize water drainage. Their limited number underscores the temporary nature of the nursery and reinforces the intended transplanting of trees to other parts of the island after a twelve-year growth period.

Fig. 8.14. – Water Redirection of Ma'noufah's Center. *Illustrated by author.*

Agro-Tourism – Neighborhoods & Marketplace

[Responding to Eco-Tourism]

In line with the parti, the agro-tourism strategy takes on a figurative interpretation of protection rather than literal barriers. To safeguard the village and similar communities within this eco-tourism model, housing and visitor accommodations are limited and reserved for local residents.

The housing communities mirror the existing village fabric and are intended to grow gradually alongside the expansion of the research center. Some units are designated for employees and their households, while others allow residents to host tourists, offering opportunities for supplemental income. These homes are designed to enhance typical Socotran lifestyles while preserving essential spatial practices—such as outdoor kitchens, indoor and outdoor Diwans, and communal family rooms. This approach promotes neighborhood cohesion and enables Socotrans to introduce visitors to local customs on their own terms, maintaining cultural authority over services like meals, transportation, and lodging.

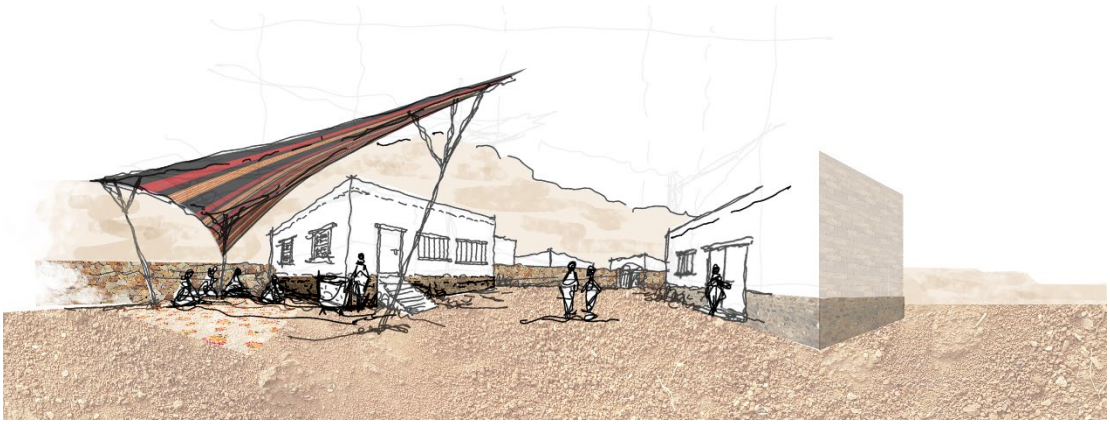

Fig. 8.15. – Outdoor Community Kitchen and Diwan. *Illustrated by author.*

The Ma'noufah Marketplace is likewise reserved for the Ma'noufah Women's Organization and other local vendors. The marketplace prioritizes community participation and retains a high percentage of locally owned stalls to prevent outside commercial dominance and ensure that economic benefits remain within the community.

Ecological Balance – Indoor-Outdoor relationships

[Reflecting on Existing Ecologies]

Each building within the Ma'noufah development maintains a deliberate relationship with the outdoors. The marketplace includes an open gathering space; the craft and trade skills center features outdoor corridors; the prayer room opens directly onto the adjacent farmland; and the research center is embedded into the ground to respond to both climate and site conditions. A system of bridge dams and a flood garden helps manage seasonal monsoon runoff, absorbing excess water and enabling movement across the site without dependence on large-scale infrastructure. Among these relationships, the prayer room plays a central role—anchoring the connection between built space, ecological function, and daily practice.

Fig. 8.16. – Prayer Hall Overlooking DBT Regeneration Farm. *Illustrated by author.*

Sustainable Foundations – Community-Centered Construction

[Socotran Sustainable Development]

A protective measure to retain the cultural and physical integrity of this development is the use of vernacular construction, which prevents non-sustainable practices that add pressure on locals and enables only expensive implementations to occur.

Construction material is mud-brick architecture with mortar and plaster, polished and painted. Another method is rammed earth, which is mostly reserved for the retaining walls that line the research center. Gabion walls also line drastic topographic dips such as the one that lines the northern edge wall of the research center's outdoor field.

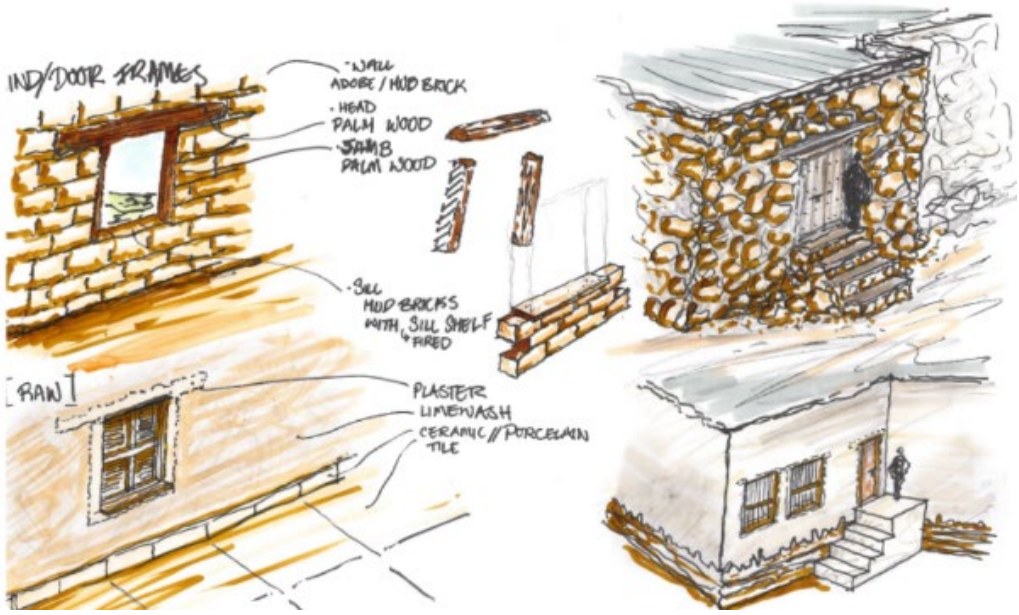

Fig. 8.17. – Traditional Construction Finishes. *Illustrated by author.*

Rigid dimensions are not fully implemented within this project, only mere estimates, due to the personal nature of the building techniques on the island. For example, most builders in Socotran villages run on estimated meters, but smaller

measurements are taken with more builder-specific measures such as the width of two spread arms, the distance between the thumb and last finger, the length of three fingers, etc.

Ultimately, the strategic growth of this development is essential to the successful implementation of an eco-tourism, or in this case, an agro-tourism model that benefits both local and visiting communities. There are various scopes of growth within this development that aim to maximize Socotra's communal development. Within the village scale, this includes tactical advancements of existing organizations and projects already semi-developed within the village's fabric. This can include informal vendors posted outside public buildings into established marketspaces, or house-based entrepreneurial businesses turned into small office spaces for small businesses. At the natural scale, the transplanted dragon blood trees are planned to grow the trees' population densities throughout both urban and rural areas. This will grow the overall dependency and restore the ecological balance of the development. At the island and initiative scale, the development of the Dragon Blood Tree regeneration farm is a model for other regeneration strategies that can be used throughout Socotra for other natural assets. This can include a marine reserve at the coastal areas and urban densities, or bird sanctuaries at the west and south natural landmarks of Socotra, and other needed points that occur for the natural benefit of the island.

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