

4-20-2020

## The Community Influence of Sponge and Coral Aquaculture in Zanzibar

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### Recommended Citation

Gaertner, Hanna; Hamad, Asma Ahmada; and Walz, J. Richard (2020) "The Community Influence of Sponge and Coral Aquaculture in Zanzibar," *DU Undergraduate Research Journal Archive*: Vol. 1: Iss. 2, Article 1.

Available at: <https://digitalcommons.du.edu/duurj/vol1/iss2/1>

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## Abstract

Aquaculture has been presented as a means of income for coastal communities, particularly in the context of climate change and resource exploitation. The NGO Marine Cultures in Jambiani, Zanzibar has established a sponge cultivation program for women in response to declining feasibility of seaweed farming from warming ocean temperatures. In addition, the organization strives to restore a severely damaged reef while providing employment for coral farmers and tour boat operators. This study analyzed the influence of aquaculture on community stakeholders, primarily with respect to sponge cultivation and secondarily in regard to coral farms. Using Marine Cultures as a case study, the principal aim was to investigate the impacts of sponge farms on the lives of women, with supplementary examination of the coral project and potential for community benefit. Participant observation and interviews were employed to generate qualitative data about the farms themselves, Marine Cultures, and the individuals impacted, predominantly women sponge farmers. The results of the study were a holistic narrative of Marine Cultures, four biographical sketches (three sponge farmers and one coral farmer) and a clear representation of aquaculture's benefits to individuals.

## Dhahania

Kilimo bahari kilifanywa ikiwa ni njia ya kujipatia kipato kwa jamii ya watu wa mwambao wa Jambiani, Katika kukabiliana na hali ya tabia nchi na uvunaji wa maliasili. Taasisi isiyo ya kiserikali ya Kilimo bahari katika eneo la Jambiani, Zanzibar walianzisha upandaji wa spongi bahari (vinja bahari) kwa Wanawake kutoka na wasiwasi wa kushuka kwa uzalishaji wa mwani kutokana na kupanda kwa joto la bahari. Kwa kuongezeka, taasisi hii inaangalia uwezekano wa kurejesha matumbawe yaliyoathiriwa kwa kiwango kikubwa wakati huohuo wakitoa ajira kwa Wakulima wa Matumbawe pamoja waendesha boti. Utafiti huu ulichunguza pamoja na kuchambua ushawishi wa kilimo bahari kwa washika dau wa jamii ya Jambiani, kimsingi kwa kuzingatia kilimo cha Spongi na kilimo cha Matumbawe. Kwa kutumia jumuiya ya "Marine Culture" eneo la Kujifunzia, Madhumuni ya msingi yalikuwa ni utafiti kilimo cha mashamba ya spongi pamoja na maisha ya wakulima wa kike, utafiti wa ziada wa kilimo cha Matumbawe na faida kilimo kwa wanajamii. Uchunguzi kwa vitendo na mahojiano ulifanyika ili kuweza kupata data kuhusiana na mashamba yao, Kilimo bahari, na waathirika, Mara nyingi wakulima wa spongi ni wanawake. Matokeo ya utafiti huu ni kwa ujumla yanasimulia "Marine Cultures," 4 michoro ya kibinadamu (3 wakulima wa spongi, 1 mkulima wa matumbawe) na uwakilishi mzuri wa faida kwa kilimo mmoja.

## Keywords

Aquaculture, Sponge farming, Zanzibar, Coral farming, Marine cultures, Community impact, Kilimo cha samaki, Kilimo cha sifongo, Kilimo cha matumbawe, Tamaduni za baharini, Athari za jamii

## Publication Statement

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## Abstract

Aquaculture has been presented as a means of income for coastal communities, particularly in the context of climate change and resource exploitation. The NGO Marine Cultures in Jambiani, Zanzibar has established a sponge cultivation program for women in response to declining feasibility of seaweed farming from warming ocean temperatures. In addition, the organization strives to restore a severely damaged reef while providing employment for coral farmers and tour boat operators. This study analyzed the influence of aquaculture on community stakeholders, primarily with respect to sponge cultivation and secondarily in regard to coral farms. Using Marine Cultures as a case study, the principal aim was to investigate the impacts of sponge farms on the lives of women, with supplementary examination of the coral project and potential for community benefit. Participant observation and interviews were employed to generate qualitative data about the farms themselves, Marine Cultures, and the individuals impacted, predominantly women sponge farmers. The results of the study were a holistic narrative of Marine Cultures, four biographical sketches (three sponge farmers and one coral farmer) and a clear representation of aquaculture's benefits to individuals.

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**Keywords:** aquaculture – sponge farming – Zanzibar – coral farming – marine cultures – community impact

## 1 INTRODUCTION

This study analyzed the relationships between aquaculture and community stakeholders in Zanzibar. The first aspect was creating a comprehensive narrative of Marine Cultures, an NGO of Swiss origin based in Jambiani. The narrative includes a timeline of the organization's history, as well as information regarding Marine Cultures' communication of their mission, relationships with community members and partners, challenges,

evaluation of current sustainability, and future goals. The second aspect was to develop a thorough comprehension of sponge farming processes via participant observation in the field, and to observe coral maintenance to understand the reef restoration project. Lastly, this study investigated the implications of aquaculture for participants. Sponge farming was examined through women involved in the project, including its potential for income generation, successes and challenges,

transferable skills, and gender dynamics. For the coral restoration component, the study then focused on coral farmers as well as a boat captain, also seeking to evaluate economic benefit, skills development, challenges, and practicality.



**Figure 1.** Underwater image of shallow water sponge farm.

Previously, no official record (aside from brief annual reports on their website) existed of Marine Cultures' history, development, community relationships, organizational goals and overall stake in addressing issues of poverty, resource exploitation, and environmental degradation in Zanzibar. Moreover, an understanding of the organization and its practices (i.e. mechanics of aquacultivation) were essential to proceed with the examination of the NGO's impacts on women who participate in sponge farming and the recent development of coral restoration. Thus, this study is a valuable resource for present and future stakeholders of Marine Cultures. In particular, the results provide a deeper understanding of community relationships with sponge cultivation through the lens of female sponge farmers as well as insights into the integration of coral restoration into the community via men who grow corals.

Since the efforts of women to address social challenges in an entrepreneurial context have great potential to impact their communities and their nations<sup>1</sup>, it is important to be aware of the effects of such activities on the women involved in them, with sponge farming as the primary example. Awareness of impacts is influential for assessment of future project feasibility on larger scales or in other contexts, as well as for the communication of human narratives that have not previously been told in depth. In fact, little is known throughout the world about Zanzibari women in general, and the limited information available tends to highlight a "mysterious" or "exotic" quality due to misunderstood cultural and religious practices<sup>1</sup>. This study assists in the alleviation of such misunderstandings and provides insights as to how women are impacted as they facilitate

productive community change.

The importance of understanding reef restoration via coral farming lies in its potential to alleviate poverty for farmers and boatmen alongside its mitigation of climate change impacts on the lagoon. The project also promotes education about coral reefs. The initiative is a relatively recent development, so a baseline examination will be helpful for future assessments of community impacts.

The menace of climate change produces a number of detrimental consequences which include depletion of marine resources, environmental degradation, and warmer ocean temperatures, each of which directly affects marine economic activities. The feasibility of seaweed production and fishing – two primary income sources for Jambiani residents – is declining. The study of sponge and coral aquaculture and their relationships to participants using the NGO Marine Cultures as a model proves important to address livelihood options in the face of community poverty.

## 2 BACKGROUND

Conceptual knowledge of Marine Cultures, sponge cultivation and coral restoration are integral to understanding the nature of the study and its implications. In addition, information about the Jambiani community provides context for the study.

### 2.1 Key Concepts

Marine Cultures is an NGO that focuses on aquaculture and marine conservation. The organization is especially concerned with the overuse of marine resources and its contribution to poverty. To address this issue, they strive to work in close cooperation with local communities whose governments lack authority and financial resources to alleviate such challenges. Funding is provided through membership fees, donations and grants<sup>2</sup>. With the intent of promoting sustainable and economically beneficial utilization of the sea, Marine Cultures spearheads marine production projects to provide community members with an understanding of economic benefits that accompany sustainable practices, with emphasis on education and capacity building. These initiatives include marker buoy placement in protected areas, conservation awareness and education, coral restoration, octopus management, and monitoring reef resilience. Most relevant to this study are the training course in sponge farming, an operation introduced to Zanzibar by the NGO in 2009, and the coral restoration project, launched in 2014<sup>2</sup>. The one-year sponge farming program instructs women (particularly single mothers) in the cultivation and commerce of sponges, with each participant receiving a sponge farmer certification as well as her own farm<sup>2</sup>. The coral project, in partner-

ship with Coral Reef Care, seeks to promote marine conservation while providing an adequate means of income for coral farmers and tour boat operators (C. Vaterlaus, personal communication, Nov. 2019). Farmers are trained in diving and coral care, and boat captains are educated about corals and marine conservation.

Sponges (phylum *Porifera*) are sessile animals that filter-feed on organic particles in the water such as phytoplankton, bacteria and detritus<sup>3</sup>. As their phylum name suggests, sponges have porous structures, with cavities through which water enters in inhalant canals and exits via expulsion<sup>4</sup>. Thousands of species can be found across the globe, in a large variety of shapes and sizes. The diversity and abundance of sponges makes them an integral component of marine ecosystems. Not only do they provide food and habitats for other organisms, but they are key contributors to primary production, nitrification, and water filtration<sup>5</sup>. Not surprisingly, sponges can hold large amounts of water which contributes to their value for people. Sponges are most widely used by humans for bathing purposes, but are also employed as antifouling agents, in antibiotics, as anti-inflammatory/ anti-viral agents<sup>3</sup>, and in various household cleaning contexts. In addition, sponges are utilized in hospitals for cleansing and medicine application, and as natural contraceptives<sup>6</sup>.

Globally, a large market exists for sponges and demand is much higher than supply<sup>6</sup>. Many people prefer real sponges to synthetic products, as they are more effective and aesthetically pleasing. Despite highly variable growth rates<sup>4</sup>, sponge cultivation was presented as a means to meet rising demand and improve uniformity of supply<sup>7</sup>, though farming sponges is documented as early as the late nineteenth century<sup>3</sup>. Sponge cultivation proves suitable for remote coastal communities due to its low-cost materials and local processing<sup>8</sup>. Moreover, sponges sell for high prices, making them a viable source of income. However, most operations are exceedingly small in scale, and 99% of commercial sponges are poached (C. Vaterlaus, personal communication, Nov. 2019). The most common production technique for sponges is the floating raft method, which entails attachment of small sponges to ropes and their suspension using floating buoys<sup>6</sup>. This process is implemented in the shallows just beyond intertidal zones as well as in deeper waters. Deep water farms have been found to be more successful but carry added challenges due to the necessity of swimming proficiency and diving equipment, which is not always possible for villagers<sup>6</sup>.

Corals (phylum *Cnidaria*, class *Anthozoa*) are a highly diverse group of animals found primarily in tropical and subtropical waters that live communally and form reefs. Coral reefs prove exceedingly valuable, as they support a high level of biodiversity which provides food, economic opportunity, pharmaceutical products, and tourist attraction. As a result of anthropogenic

influence, such as overfishing, pollution, and climate change, the world's reefs have been significantly degraded. Corals may be raised for reef restoration, commercial purposes, or drug discovery<sup>9</sup>. In tropical and subtropical areas (i.e. Tanzania), cultivation takes place in the field<sup>9</sup> as opposed to land-based aquariums. This is advantageous because if sites are selected appropriately, costs of maintaining suitable environmental conditions are eliminated. Moreover, coral cultivation has the potential to be beneficial in terms of biodiversity preservation, disturbed reef rehabilitation, and the reduction of wild coral harvest for the curio trade<sup>10</sup>. For growing corals, the cutting method is primarily used, in which 5-10cm pieces of coral, called "nubbins," are cut from mature corals and secured to hard surfaces<sup>9</sup>. Hard corals, which produce calcium carbonate skeletons, are primarily grown since they provide the structure necessary to build reefs<sup>11</sup>. Growth rates are impacted by a number of factors, such as light, water motion, temperature, and nutrient availability. The impacts are species specific which creates added complexity to the cultivation process<sup>10</sup>.

Coral aquaculture or coral farming has been introduced as a means of mitigating loss of coral and providing alternative livelihood options for coastal communities, such as those in Jambiani, Zanzibar<sup>2</sup>. In Madagascar, community-based coral aquaculture was introduced in 2008 to fishermen without alternative livelihoods to fishing. The project was deemed economically and environmentally feasible for small-scale village operations<sup>9</sup>. Similarly, the relatively recent establishment of the coral project in Jambiani is promising in that it addresses the likelihood of decreased profitability of fishing in the years to come.

## 2.2 Study Site: Jambiani, Unguja, Zanzibar-Tanzania

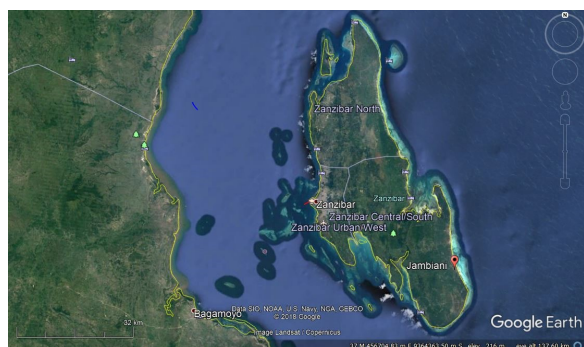
Unguja is the largest island in the Zanzibar Archipelago in the United Republic of Tanzania in the western Indian Ocean. As a result of relatively recent historical colonial rule, Zanzibar lacks a diversified economy necessary for economic development, with most income generated from tourism and fishing. Much of the island's population subsists on the equivalent of approximately \$1 USD per day. The primary language spoken in the Archipelago is Kiswahili, which is important given that interviews were a major component of the investigation (see Methods). The location of the study was Jambiani, a collection of villages measuring 70 km<sup>2</sup> in area<sup>11</sup> with 10 km of shoreline<sup>6</sup> on the eastern coast of Unguja, approximately 40 km southeast of Stone Town. It is situated south of Paje and north of Makunduchi.

Jambiani is comprised of five villages in a line, which from north to south are Kibigija, Bahani, Mbuyuni, Mwinyiwagogo, and Kikadini. All five villages were



represented by interviewees whose homes were visited. The population of Jambiani continues to increase, which exacerbates issues related to income as well as strain on marine resources. The population is approximately 9,000 people<sup>1</sup>, about 52% of whom are women<sup>12</sup>. Seaweed farming is one of the primary economic opportunities for women in Jambiani; on a given day it is possible to see 300-400 women out at work (C. Vaterlaus, personal communication, Nov. 2019). However, its feasibility and sustainability have lately decreased due to warming ocean temperatures and product price reduction<sup>13</sup>. In response, the production and sale of sponges provides an alternative means of economic support to individuals and families struggling to meet basic needs, especially since sponges are relatively tolerant of warmer temperatures. Though they are fairly resistant, warming associated with climate change can increase sponges' vulnerability to disease and inhibit growth<sup>3,7</sup>, which would jeopardize the recent cultivation developments. Many men in Jambiani are fishermen, which is no longer a sustainable source of income due to depleted fish stocks from reef degradation and overfishing. Thus, coral farming and tour boat operation to view coral restoration provide alternate livelihood options that also assist with the mitigation of climate change impacts.

Studies were conducted at Marine Cultures headquarters, in the village and in the coastal waters where the sponge and coral farms are located. Jambiani was selected as the most logical study site given that Marine Cultures and its marine projects are based in the village and lagoon. Being located in Jambiani was not only essential to observe the sponge and coral farms, but also provided opportunities for in-person conversations with Marine Cultures staff, female sponge farmers, men involved in the coral project, and other community members whose input was invaluable to this study.



**Figure 2.** Google Earth image that depicts the location of Jambiani on Unguja, Zanzibar-Tanzania.



**Figure 3.** Image of Jambiani coast, which is utilized extensively by local residents and tourists.

### 3 METHODS

The methods employed were interviewing and participant observation. Slightly different strategies were used for interviewing Marine Cultures staff, sponge farmers, neighbors and men involved in the coral project. Primarily observation was utilized for the corals. Informal interviews and dialogues also assisted in data collection.

#### 3.1 Interviews of Marine Cultures Staff

Semi-structured interviews were held with Christian Vaterlaus, the managing director and Okala Mohammad, the former project manager of Marine Cultures. Each individual was in a position to provide extensive information about the nature and narrative of the organization's history. Questions were posed (see Appendix 1) that focused on the story of the NGO, specifically its history, mission, role in the community, successes, challenges and goals, with follow-up questions based on the answers provided. The semi-structured format was selected due to a desire to gain specific information without limiting the scope of responses as well as to account for the possibility of interviews being conducted simultaneous to other activities such as introduction to the farms. Handwritten notes were taken for later analysis and development of a timeline of the NGO. Mohammad's interview was approximately 90 minutes in length and Vaterlaus's was about 80 minutes in length. However, many questions were answered by Vaterlaus and Connie Sacchi, a Marine Cultures Associate, during conversation throughout the study period.

#### 3.2 Participant Observation of Sponge Farming

Sponges and the nature of sponge farming were studied via participant observation to better understand the farms and their operations. The formal definition of participant observation is "discovering through immer-

sion and participation the hows and whys of human behavior in a particular context”<sup>14</sup>. Participant observation was selected in order to gain a multi-dimensional comprehension of sponge farming through the combination of factual information and sensory experience. Moreover, the extensive time involved in participant observation enabled thorough data collection. The process involved engagement with Marine Cultures staff in addition to female sponge farmers. Activities included cleaning, trimming, planting, harvesting, and processing sponges as well as cleaning ropes. The deep-water nursery farm was also observed on one occasion (see Method 4). Data was collected in the form of written observations after return from the sea and pictures were taken to serve as visual aids. Study of the farms began during the first week of the study period, since an understanding of sponge cultivation was desired before the investigation of Marine Cultures and interviews with sponge farmers. Five time periods of approximately three hours were used for data collection. Informal interviews with Ali Mahmudi and Ali Pandu occurred alongside the participatory activities, in addition to brief dialogues with the women. Interviews with farmers began before the completion of participant observation out of convenience.

### **3.3 Interviews of Female Sponge Farmers**

Ten active sponge farmers were interviewed formally to gain insights into the nature of sponge farming and its impacts. Interviews were structured due both to a language barrier and the pursuit of precise information about the lives of the women. This process took place during the beginning of second week of the study period and continued through the third week. Prior to asking questions, a brief introduction was provided to explain and give context to the study. Each interview was conducted with the assistance of a translator due to lack of fluency in *Kiswahili* and interviewees were given the opportunity to ask their own questions so as to avoid confusion about the project. Interviews were approximately 30 minutes in length. When possible, interviews were recorded to facilitate precise quotations and to limit the need for follow-up interviews. Questions (Appendix 2) addressed each woman’s role in sponge cultivation, how and when she became involved with Marine Cultures, ideas about the impacts of farming on her life, her responsibilities besides sponge farming, and how farming integrates into her life on a daily basis. In addition, three farmers were selected for further interviews based on their availability and recommendations. Their answers were used in the creation of biographical sketches (shorter and more specific versions of biographies) for each of the women interviewed. Responses from all interviews supplemented participant observation for discussion of how sponge cultivation impacts

women in Jambiani.

### **3.4 Observation of Coral Farm and Deep-water Sponge Nursery**

A boat was taken to view the sponge nursery, coral growth operation, and the house reef currently under restoration. Reef balls, coral cleaning, checking of nursery sponges, placing of coral tables, and the status of the house reef were observed in a single outing. Participation was not possible given an inability to dive per SIT policy, therefore data was collected via snorkeling. However, swimming down to observe was possible given that depth did not exceed 10 m. Pictures were taken to serve as visual aids. The observation period included a brief dialogue with Rolf Voorhuis, founder of Coral Reef Care. This exchange was integral to understand the reef restoration initiative in Jambiani lagoon.

### **3.5 Coral Project Interviews**

Three coral farmers and one boat captain were interviewed about the coral restoration project. Interviews were structured, assisted by a translator when necessary, and lasted approximately 25-minutes each. Interviews were conducted individually, but all interviewees were present. Questions for the coral farmers (Appendix 4A) concentrated on the nature of the job and the benefits in terms of skills and income. In addition, inquiries were made about each individual’s life to be used in the creation of a biographical sketch, based on the interviewee that provided the most thorough information. For the boat captain, questions (Appendix 4B) focused on the Chumbe training, the value of the job, and marine conservation. Only one boat captain was interviewed due to a lack of availability.

### **3.6 Interviews of Jambiani Neighbors**

Based on sponge farmer recommendations, four women in the community who are not farming were interviewed in an effort to gain insights regarding awareness of Marine Cultures and their aquaculture projects, perceptions of the overall operation and why they do not participate (See Appendix 3). Interviews were structured, assisted by a translator when necessary, and were approximately 30-minutes each. One young man was also briefly interviewed about his awareness of Marine Cultures and the cultivation of sponges and corals. Questions were posed in and around the homes of interviewees out of convenience and to maximize comfort for interviewees. Interviews were utilized because they are the most direct method of obtaining individual responses.

## 4 RESULTS

Interviews and conversations with Marine Cultures staff were used in the creation of a timeline that depicts the organization's history. The timeline serves as a launching point for discussion of aquaculture, NGOs and community influence. Participant observation provided substantial information to develop an understanding of sponge cultivation in terms of the processes involved, technical knowledge required, challenges, and sensory experiences. Sponge farmer interviews provided insights into the benefits of sponge cultivation and its integration into the lives of women in Jambiani. Furthermore, the interviews enabled the creation of three biographical sketches. The observations of coral restoration proved informative with regard to the implementation of coral farming in the Jambiani lagoon. Interviews with coral farmers were beneficial to understand the nature of the project and advantages of the job, in addition to the generation of one biographical sketch.

### 4.1 Marine Cultures Narrative

A timeline (Table 1) was constructed to depict key events and milestones for Marine Cultures from its establishment up to the present, including desired future outcomes. Data was integrated from interviews, informal dialogue with the staff in the organization, and annual reports.

After years of traveling away from his home in Switzerland, Christian Vaterlaus decided to explore the possibility of living abroad. He and Connie Sacchi visited Zanzibar several times, eventually building a house on a property in Jambiani to comply with the government. They saw the poverty, declining marine health, and the decreasing feasibility of coastal activities such as seaweed production (C. Vaterlaus, personal communication, Nov. 2019). A new and sustainable practice was necessary; Marine Cultures was born in 2008 as a result of a desire to work alongside the community to address oceanic and socioeconomic issues, with aquaculture being at the intersection of the two. Aquaculture not only makes products that can be sold to generate income, but it also leads to conservation because people are motivated to care for the sea (C. Vaterlaus, personal communication, Nov. 2019). Christian found Okala Mohammad, head of the NGO Jambiani Marine and Beach Conservation (JAMEBECO) and the two discussed ideas, eventually developing the sponge project together (O. Mohammad, personal communication, Nov. 2019).

Cultivation of pearl oysters was explored, but ultimately sponges were selected as the focus due to the ability to operate with relatively simple equipment. From 2009 to 2012, sponge experimentation took place

in collaboration with several research institutes. The process included the identification of 140 species, the exploration of biomedical applications and a thorough evaluation of the market potential (C. Vaterlaus, personal communication, Nov. 2019). This was a difficult task. For example, one species grew well for 3 years, but could not produce brood stock and therefore could not be grown sustainably. Eventually the *Callyspongiidae* family was selected for growing common bath sponges.

### 4.2 Participant Observation of Sponge Farming

The majority of work in the cultivation of sponges takes place around the full and new moons in the lunar cycle. When the height of the low tide is less than about three-fourths of a meter, the coastal waters are shallow enough to conduct work. The women go out to the farms during the low tide, usually four days before and after new and full moons and spend two to three hours each day tending to the sponges, but sometimes up to six hours in a day. Required equipment includes tools (bike chain, knife, and dead sponge), mask, snorkel, dive boots, fishing lines, and a bag or *kanga* to collect green algae. The farmers prepare together, suiting up, gathering equipment, and sharpening their knives. Returning from the farms involves showering and cleaning and organizing their daily equipment.



Figure 4. Sponge Farmer 1 and project manager inspecting sponges.

Planting begins in the deep-water nursery, where large sponges are grown and cut to start new farms, with the seedlings growing below (Figure 5). To plant,



**Table 1** Timeline depicting key events in the history of Marine Cultures

2008	Establishment of Marine Cultures NGO
2009	Sponge farming introduction to Zanaibar, exploration and research began
2012	Discovery of sponge species that can be trimmed to make seeds - <i>Calyspongiidon</i>
2014	Started growing corals for aquarium trade
2015	Had to abandon unproductive sponge farm in Mtende, began growing coral for aquarium trade
2016, May	First two women became independent sponge farmers, great year for production
2016	Spread to Mafia with Chole marker buoys, noticed by foreign NGOs, media coverage increased visitors
2016	El-Nino destroyed >50% reef and coral project
2017	More bleaching and destruction of coral project, shifted focus to resistant corals, restored 1 <sup>st</sup> bit of reef with 300-400 corals
2017, Dec	All 10 sponge farms sustainable, no more wild sponges needed
2018	Sponges suffered from brittle star epidemic
2019	Bahari Salama film produced, focusing on marine conservation/ aquaculture in Jambiani
2019, Fall	Worst case of green algae fouling on sponge farms ever experienced, moved into new office building
2021/2022	Sponge farming 100% community owned

a clean plastic wire is run through the center of a round sponge, tied in a loop and attached to the rope by pulling the sponge through the loop. Sponges are checked for growth of cyanobacteria, algae, and invertebrates during each farm visit. The shaping of sponges is done with a utility knife and fouled, or protruding pieces, are removed to form a clean round shape. Precautions to minimize sponge deaths include not squeezing sponges and never cutting pieces bigger than one-third of their body sizes. Sponges are cleaned by hand or with a dead sponge to carefully remove algae, invertebrates, or other particulates that may increase mortality. To clean the ropes, farmers vigorously scrub them with a bike chain to remove thick algae coatings. Cleaning does not happen every day since time is limited and there are thousands of sponges. Since it would be impossible to address each and every sponge each day, farms have “special care” lines, where promising sponges are placed for a few months to a year so as not to overlook them. The special care sponges are checked and cleaned more thoroughly than the remainder to maximize their selling potential.

When aesthetically pleasing sponges are large enough, they are harvested which entails taking them off the line, squeezing and rinsing them in the ocean, and collecting them in mesh bags. Harvested sponges undergo an extensive cleaning process, in which farmers wash sponges twice with harita (a natural soap) while carefully picking out shells and debris. Sponges are then placed in an acid solution for 20 minutes (Figure 6) followed by a powder-water mix for about 1

**Figure 5.** Deep water sponge nursery (left) and planted sponges (right).

minute. After rinsing, farmers again wash the sponges with harita, squeeze them and let them dry. The process is repeated, if necessary, to remove odors and foreign objects. Quality control is strict, and inadequate sponges are discarded. They are sold for either \$25 or \$30 USD, depending on the size and the quality, and farmers take them to shops around the island to be sold.

The primary challenge during the observation period was a plague of green algae, known as *majani*, that attaches to sponges and suffocates them (Figure 7). This time was particularly problematic, likely due to heavier than average seasonal rains (C. Sacchi, personal communication, Nov. 2019). A large portion of participant observation involved removing *majani* from sponges and ropes and taking full bags of it away from the farms. Other observed difficulties include navigating around massive urchin clusters, wind and wave action, rain and cold water, operating at the mercy of tides, fatigue, and, unfortunately, the death of sponges (Figure 8).



**Figure 6.** Sponges soaking in acid and water solution during processing.



**Figure 7.** *Majani* (green algae) covering sponges and ropes.

#### 4.3 Sponge Farmer Interviews and Biographical Sketches

Of the ten farmers interviewed, seven previously cultivated seaweed and said that sponge farming is much better than seaweed farming since profits are higher and labor is less intensive. Other prior jobs mentioned included housekeeping, small trade, agriculture, and the collection of firewood. Almost all interviewees reported that they heard about Marine Cultures from other people, whether villagers, Marine Cultures staff or other farmers in the area. The few remaining interviewees either forgot or did not provide an answer to the question. Previous experience farming ranged from a little over one year up to six years.

Four interviewees specifically stated that other means of income generation were not necessary to supplement the sale of their sponges. Nearly all interviewees relayed that they participated in small trade activities, such as selling *chapati* (a flat bread) or *kofia* (embroidered hat), but no other significantly demanding jobs were reported. Outside of sponge cultivation the primary responsibilities mentioned for the sponge farmers were as follows: childcare, food preparation, household chores,



**Figure 8.** Large urchin cluster (left) and dead sponge with evidence of algae and cyanobacteria, as well as a brittle star living inside.

firewood collection, small farm operation, sewing *kofia* and errands (i.e. to Stone Town). Only one farmer expressed difficulty with balancing sponge farming with her other responsibilities, and a majority of interviewees cited effective time management as the reason for their ability to accomplish all activities each day.

All of the farmers interviewed explained the economic benefits of sponge cultivation and noted that it enabled the successful achievement of their goals or dreams. Five interviewees specifically mentioned that sponge farming enables them to cover basic needs, five mentioned its role in caring for their children (especially paying for school), and five described its assistance in home upgrades or construction. The purchase of other goods such as a refrigerator to start a juice business and furniture purchases were also attributed to income generated from sponges. Independence was also cited as a positive outcome of sponge sale by about half of the farmers, as they appreciate the freedom to run their own lives. Only two farmers did not view independence favorably due to the added pressure to succeed that accompanies self-employment.

When asked how others perceived sponge farming, responses focused on the achievements whether out of curiosity, excitement, or jealousy. Five women said that people see the sponge farming as comparable to other economic activities and one woman stated, “*At first people saw us differently because we quit seaweed farming. They thought we were wasting our time until they saw the benefits, now they see it favorably like other jobs*” (Sponge Farmer 1, translated). A handful of sponge farmers mentioned that people thought it was unusual for women to swim and were therefore unsure what to think about the job. Ideas about how men perceive sponge cultivation varied considerably. Some said men think farming is easy, others that men think it is too difficult for women. A few felt that men are indifferent, and one said that men say to continue because of the benefits to women and their families.

Six women explicitly stated that they would like to have more sponge farmers so that more families could receive the benefits. Only one expressed moderate concern for the added complexity of farming with additional people. In addition, one farmer remarked, “*More*



farmers would be beneficial because different people have different skills, talents, and ideas that could be utilized to assist one another” (Sponge Farmer 7, translated). Four women had neutral or no answers about the number of farmers. When asked what they would tell people who aren’t farming, eight women said they would explain the cultivation process and benefits in their lives.

Interview responses enabled the creation of three sponge farmer biographical sketches: Aysha Said, Fatima Mohammad and Latifa Salim. Each brief biography depicts an abbreviated life history with emphasis on the impacts of sponge cultivation. Pseudonyms were created for privacy purposes; the author has original names.

#### 4.3.1 Aysha Said

Aysha was born in Zanzibar City (Stone Town) and lived there with her parents. Her parents passed away when she was young, so she went to live with her grandparents in Bambi (central Unguja). She finished school there, then moved to Jambiani where she was married and gave birth to four children. Aysha and her husband divorced, so she lived as a widow for six years and during that time was recruited by Marine Cultures to become the first sponge farmer. She has been cultivating sponges for six years and operates independently. Prior to sponges, she was a seaweed farmer, and says sponges are a significant upgrade since she can provide for basic needs, pay school fees for her kids, and does not need to do other activities to generate income. Aysha remarried two and a half years ago, and now lives with her husband and two kids in Jambiani Kibigija.

Depending on the tide and status of her farm, Aysha typically spends two to three hours but up to six hours working during the eight to nine days surrounding full and new moons. Outside of sponge farming, she balances a number of other responsibilities, including taking care of her children, cooking, cleaning, and collecting firewood. She says that using time effectively is the key to managing everything. When she has free time, Aysha enjoys being in her home either doing domestic tasks or making small trade items such as *kofia* and has also developed skills as a dress designer.

Aysha is immensely humble, but one thing of which she is proud is being a sponge farmer because she has the capability to run her life without reliance on others. She would like to be known for being a skilled swimmer someday and is working hard to reach that goal. One moment in her life she says she will never forget was when she almost drowned in the ocean. Aysha offers advice she has learned that “*Changes can come at any time, so one has to adapt and be dynamic*” (Said, translated).

#### 4.3.2 Fatima Mohammad

Fatima grew up in Jambiani with her three brothers and seven sisters. She has always lived in Jambiani and her



Figure 9. Aysha Said

family is there, too. After completing her studies, she was married and had two daughters before she and her husband divorced. After the divorce, she had another child who is still a baby, and currently lives with her three children. Fatima likes sponges and has been cultivating them for three years now. When asked about something of which she is proud, Fatima replied, “*I am proud to be a sponge farmer because I have the ability and economic means to run my own life. I enjoy not needing to rely on others to support myself and my children*” (Mohammad, translated). Fatima says she has already benefitted a great deal from sponge farming, since she has been able to buy furniture and send her daughters to school in addition to adequately covering basic needs. Plus, she is currently in the process of finding a place to build her new house.

Fatima’s favorite food is *chipsi* (French fries) and can be found sewing in her free time, as she truly enjoys making *kofia*. She says free time is when she is not working on the sponge farm, since that is her daily activity and otherwise, she would have to say she does not have free time. Outside of sponge cultivation, she is responsible primarily for childcare, especially since she has a baby to look after. She also cooks and runs her household and like other farmers balances everything with effective time management. One significant event that Fatima says she will never forget is when someone stole a large amount of money from her house. She struggled



Figure 10. Fatima Mohammad

to recover from the loss.

#### 4.3.3 Latifa Salim

Latifa has lived in Jambiani since she was born, growing up and completing her studies in Jambiani Bahani. She has three siblings: two brothers and a sister. Latifa has two children, one son and one daughter. Currently, she lives with her husband and one of her children. Her other child lives with a grandmother. She takes full responsibility of her children and balances parenting with sponge farming with efficient time management. During her free time, Latifa chooses to rest, especially after working in the sea. Her favorite dish to eat is rice with roast sauce.

Prior to cultivating sponges, Latifa was a seaweed farmer and collected shells on the beach to sell. She heard about Okala and his work on the island before she heard about Marine Cultures because people were saying that women were diving there, which was surprising to her. She was given the opportunity to join the sponge farmers after someone told her about the job, answering her questions to remove misconceptions. She was intrigued and has now been farming for three years, operating independently. One thing Latifa would tell others about sponge farming is the reality of the work required with explanations of the processes involved. She says, *“People see the difference sponge farming has made in my life because of my achievements, for example obtaining land to build a new house which I previously could not do”* (Salim, translated).



Figure 11. Latifa Salim

Latifa will be proud when she has her own house, the construction of which is being funded by income generated from selling sponges. She says she has learned a lot in her life, but the biggest lesson is adaptability. Since times always change, one has to be ready to learn new things. For example, collecting shells used to be a good source of income for Latifa but when that was no longer feasible, she had to learn something new to support herself and her children. In this case, that thing was sponge farming.

#### 4.4 Coral Restoration Observation

Corals are grown on about 40 tables on the sea floor in the Jambiani lagoon with the purpose of restoration and response to damage as a result of climate change. Marine Cultures partners with Coral Reef Care, a Dutch NGO focused on protecting and rebuilding reefs. To begin, “corals of opportunity” - or pieces naturally broken for example by boats or storm - are attached to cement pieces and placed on tables (Figure 12). After three to eight months, the cement plugs are inserted into reef balls to create an artificial reef or attached to substrate to repair the adjacent house reef (Figure 13) which was 90% destroyed by El-Nino in 2016 (C. Vaterlaus, personal communication, Nov. 2019).

Managing the coral farm includes moving tables, cleaning corals with small brushes, scrubbing tables,





Figure 12. Small corals “planted” on tables.



Figure 13. House reef that is under rehabilitation in the Jambiani lagoon.

and monitoring coral health (Figure 14). Due to the seafloor location in relatively deep water, diving equipment is necessary for maintenance which creates significant expense and safety considerations. In addition, operating machinery has the potential for injuries such as cut fingers and working in the ocean means the possibility of harm from marine wildlife. Farmers typically visit the corals four times per week for a few hours each time.

#### 4.5 Coral Project Interviews and Biographical Sketch

Prior occupations of coral farmers included as a cook, dive shop employee, and farmer, in addition to the common occupation of fishing. Interviewees reported no need to do other activities for income generation. Two out of the three coral farmers interviewed said that support of their parents was a primary benefit of their job, with the third mentioning that he was able



Figure 14. Divers inspecting and cleaning nursery corals.

to care for his wife and five children that rely on his income. Other advantages to coral farming included skills such as diving and technical knowledge, materials for home construction, and the freedom to purchase items beyond basic necessities.

The predominant challenge explained was the potential for minor injuries. One farmer relayed that he “*got a stick in [his] stomach once, and another time hit [his] head*” (Coral Farmer 2, translated). Another farmer mentioned that he occasionally cuts his fingers and that using tools yields accidents. Also, diving each day can be difficult for logistical reasons as well as fatigue.

Two farmers noted that people see the coral project as comparable to other jobs and one said people are uneasy because they think the job is too dangerous. To those unsure about joining, the farmers would say that it is a good job and explain their daily activities. One farmer elaborated, “*[coral farming] is not only important for personal benefit, but for the community and for environmental conservation*” (Coral Farmer 2, translated). The farmers and the boat captain all spoke about the necessity of conservation in the Jambiani lagoon, for instance, one argued, “*Coral restoration is a good job because conservation is important and having more corals will attract more tourists in the future and therefore increase income*” (Boat Captain, translated). Conservation was also a reason cited for a desire to see more coral farmers and boat operators, in addition to increasing the efficiency and the effectiveness of the reef restoration project.

Interview responses were utilized to create one coral farmer biographical sketch for Juma Ali Omar. The sketch depicts a brief history with a focus on coral farming. A pseudonym was created for privacy purposes, the author has the original name.

##### 4.5.1 Juma Ali Omar

Juma was born in Makunduchi (just south of Jambiani) and raised in Jambiani, with four sisters and one brother. His first jobs were fishing and farming. He started

working with Marine Cultures about six years ago. He was interested in marine work given his fishing background and was curious about planting sponges and corals. Juma continues to fish occasionally and helps his parents plant crops such as cassava, but being a coral farmer is an adequate source of income for him. Juma says that the primary benefits of his job are the ability to support his parents and other family members in addition to having the capital necessary to buy building materials for his house. Also, he has a number of skills including diving, knowledge of corals, sponges, and the cultivation of each, using power tools, fixing tables and swimming. He is proud to own his own house as well as a motorcycle.



Figure 15. Juma Ali Omar

In a typical day of work, Juma spends up to five hours completing tasks such as planting corals, moving tables, cleaning corals, and repairing equipment. He says one challenge of the job is that using tools can result in accidents such as cut fingers. Juma would like to have more coral farmers so that more of the reef damage can be mitigated. He thinks that community members view his work like any other job but in reality, it is special because it has a broader goal of restoration, and the results cannot be seen day to day since coral grows slowly.

In his free time, Juma likes to learn about marine environments, corals, and sponges on the internet to be better informed. He thinks about how to improve the efficiency and effectiveness of his daily work. One experience he will never forget is his first time traveling by plane, which felt as though he was dreaming, and it was an opportunity provided by Marine Cultures. Juma cites his favorite foods as being cassava, *njugu-*

*mauwe* (white bean/ ground nut), and *viazitona* (potato dish). The most important lesson he has learned from the challenges of others is to work hard, doing whatever it takes to avoid unemployment and the resulting difficulties.

#### 4.6 Jambiani Neighbor Interviews

Two of the interviewees were young women, one a middle-aged woman, one an older woman, and one a young man. All of the interviewees expressed an awareness of Marine Cultures, reported knowing at least two sponge farmers, and mentioned their familiarity with seeing farmers as they walked to and from work. Each person interviewed articulated an interest to learn more about Marine Cultures and sponge farming, with the exception of one woman who knew a great deal from previous experience. Two individuals visited farms once, two had never visited farms, and one tried sponge farming but had to quit due to health complications. Only one interviewee reported not speaking with farmers to answer questions about the job and its potential benefits. One hundred percent of respondents said they would like to become sponge farmers if possible, generally citing economic benefit or poverty alleviation as their reasoning. Awareness of the coral restoration project was minimal; two interviewees had never heard of it, two had a vague awareness of fishing bans or people interested in protecting the reef, and one had seen people diving near the reef. Only two individuals expressed interest in learning more about the coral project.

### 5 DISCUSSION

Based on interview responses and participant observation, sponge farming significantly impacts the lives of women in Jambiani, and the most obvious benefits are economic. The growth and sale of sponges enables mothers to adequately provide for their families which is especially profound for divorced or widowed women. Evidence lies in the conveyed abilities to invest in home improvements, afford school for children, and account for personal needs.

A noticeable social benefit was also observed. The farmers have created their own micro community, which is evidenced by frequent talking, joking and laughing especially during work at the farms. This comradery could be the result of extensive shared experience in sponge cultivation, former friendships, mutual ties to the community of Jambiani, or any combination of the three. However, it is important to note that social relationships were not studied in depth, and farmers did not directly mention friendships when speaking about positive outcomes of sponge farming.

In addition, participation in sponge farming develops a number of valuable skills that may otherwise not

have been acquired, and that possess the potential to be applied to other economic pursuits. For example, knowledge of how to swim is uncommon for women in Jambiani. Swimming ability not only mitigates mobility challenges in traveling to and from the farms but could also be useful for other marine activities. Plus, knowledge of cultivation processes could potentially be useful for other aquaculture endeavors, for example the new sea cucumber and shellfish project under development. The development of communication skills is evident given that many interviewees referenced telling others about how to grow sponges and how it has changed their lives. Moreover, the capability to explain sponge farming builds confidence. Women are completely responsible for selling their sponges, so they develop a detailed understanding of business practices, specifically marketing, management and communication; this will be particularly useful when the project is run as a co-op independent of Marine Cultures. Such skills are valuable in any economic setting, so if sponge farming were to become impractical, women would be equipped to pursue other modes of income. Whether or not farmers are aware of the value of their skills was unclear.

Neighbor interview responses offered a small amount of insight into potential reasons for people not cultivating sponges. For example, one interviewee expressed a lack of interest in the sea, which could be true of a number of other Jambiani residents as well. Also, many dialogues and a few interviews indicated that some people are afraid of the ocean or discouraged by their inability to swim. Moreover, most of the neighbors stated that they are satisfied with their current jobs, so it may be that some individuals do not see a need to pursue new economic opportunities. However, only a handful of community members were interviewed, and all of them were friends or family of sponge farmers, so data is realistically insufficient in depicting community attitudes of aquaculture. Also, since the coral project is a relatively recent development and involves a select few people, awareness of the operation was minimal and thus interest levels could not be assessed. In reality, the most likely cause for lack of participation in aquaculture (specifically sponges) lies not within the community of Jambiani but on the Marine Cultures side of the operation, by no fault of theirs. Funding comes primarily from membership fees and grants, which can fluctuate and obviously are not infinite. Plus, thousands of sponge seeds are needed to start a new farm and harvesting them from the wild would oppose the commitment to environmental sustainability. Also, the addition of more staff to run the project would prevent the managing director from being able to be “on the ground” working alongside community members since more management of people would be required (C. Vaterlaus, personal communication, 2019).

The coral reforestation initiative holds a great deal of

promise. Interview results indicated that coral farmers are quite enthused about the job itself, the skills they have learned and the knowledge they have gleaned. Their awareness of the importance of conservation is likely a result of their training by Marine Cultures, since sustainable management of the sea is one of the key components of their mission. The interview results pointed to a broader sense of the significance of the coral project, since the benefits to the community and the environment were emphasized in addition to personal gains. While only one boat captain was interviewed, his responses suggest that the Chumbe training and tour boat operation will be a promising source of income and prove important in the broader context of conserving marine resources.

Marine Cultures exists as an example of a successful NGO in Zanzibar. Primary evidence lies in the fact that women farming sponges as well as coral farmers can speak to tangible benefits as a result of the organization’s efforts. While it is fairly common for European NGOs to be successful in facilitation of progressive community change as a result of higher education and resources, it is not as common to address the measures necessary for impacts to last beyond the organization’s presence in the community. In order to do so, knowledge beyond technical skills such as writing proposals, obtaining materials, budgeting, and finding sponsors must be shared with local residents, especially given that foreigners tend to eventually leave (O. Mohammad, personal communication, Nov. 2019). The initiative to have sponge farming be 100% community owned in the next three years demonstrates the pursuit of solutions by Marine Cultures that are actually sustainable long after the NGO is no longer in Jambiani. If and when it happens, it may be that eventually more farmers could be involved since the operation would ideally be self-sustaining. From the perspective of the women this would be beneficial, since most stated that they wanted to see more people involved in sponge cultivation.

While Marine Cultures operates on a relatively small scale in terms of personnel, the impacts on community members are significant and deserve to be recounted. The ability of staff to be “on the ground” working alongside community members is a component of the organization’s mission, allows for ease of management (C. Vaterlaus, personal communication, 2019), and enables the formation of intentional and intimate relationships.

## 6 CONCLUSION

Aquaculture exists as an influential and productive means of income for coastal communities facing climate change and resource exploitation. In Jambiani, Marine Cultures successfully addresses the intertwined issues of poverty and decline of ocean health via the establishment of sponge farming and coral reforesta-

tion. This study analyzed the influence of aquaculture on community stakeholders, primarily with respect to sponge cultivation and secondarily in regard to coral farms. The principal aim was to investigate the impacts of sponge farms on the lives of women through a case study of the NGO Marine Cultures in Jambiani, with supplementary examination of the coral project and potential for community benefit. Through participant observation and interviewing, a narrative of Marine Cultures, four biographical sketches, and a representation of how aquaculture benefits Jambiani residents were generated.

Depletion of marine resources, environmental degradation, and warmer ocean temperatures as a result of climate change prove detrimental for the marine economic activities, specifically seaweed farming and fishing. Jambiani is not alone in its struggle to develop sustainable economic opportunities for a growing population as the earth's natural processes shift from anthropogenic influence. Thus, this study of sponge and coral aquaculture and their relationships to participants via the case study of Marine Cultures NGO proves important in terms of livelihoods in the face of poverty for coastal communities.

## 7 RECOMMENDATIONS

In order to maximize the effectiveness of the study, communication and planning with Marine Cultures prior to project development would be beneficial. In addition, more extensive collaboration with the translator for question generation and more knowledge of *Kiswahili* may have produced more detailed results from interviewees. One of the primary limitations of the study was that ample answers to all questions were not obtained from all interviewees. This was likely due to a language barrier, specifically insufficient knowledge to generate effective follow-up questions.

Future research should include a more randomized selection of Jambiani residents to provide insight into community awareness and opinions of sponge cultivation, as well as more completely gauge the level of interest community members have to participate in aquaculture activities. Since only a handful of neighbors were interviewed and all were acquaintances of sponge farmers, the results could only provide a glimpse of why people are not involved. Further, awareness of Marine Cultures and aquaculture projects were likely much higher than other people in Jambiani and therefore was not be an accurate representation of the village as a whole.

In the years to come, examination of Marine Cultures should occur to add to the narrative, investigate how community influence has changed, and whether or not sustainability has been maintained. In particular, the effectiveness and impacts of the reef restoration project

should be evaluated since the project is a relatively recent initiative.

Knowledge of Marine Cultures, its successes, and impacts on aquaculture participants are beneficial for other NGOs with similar interests in sustainably and alleviating poverty. The results of this study exist as a model for establishment that includes anticipation of challenges and a framework for implementation. Moreover, the information generated about aquaculture – technical knowledge as well as stakeholder benefits – is a resource for coastal communities facing similar problems around the world. This study provides support of development of other aquaculture projects in the Zanzibar Archipelago, since environmental and socioeconomic sustainability work together successfully.

## 8 ACKNOWLEDGEMENTS

First, I would like to thank Marine Cultures for their immense hospitality and willingness to assist me each day. Thanks to Ali Mahmudi for his patience in translation and answering numerous questions. The sponge farmers deserve a special thanks, as they warmly welcomed and taught me a great deal; it was truly an honor to work with them. Another thank you goes to my advisor Asma Ahmada Hamad, whose previous research guided my project development and whose expertise was greatly appreciated. Finally, I need to thank Said Omar, Richard Walz, and the staff at SIT, without whom this project would not have been possible.

## 9 EDITOR'S NOTES

This article was peer reviewed.

## 10 APPENDICES

### 10.1 Appendix 1: Interview Topics for Marine Cultures Staff

#### 10.1.1 Christian Vaterlaus, Managing Director

1. What was the initial motivation for the establishment of Marine Cultures? Has the mission changed at all over the years?
2. What were the primary challenges of establishing an NGO in Zanzibar?
3. How did you go about introducing sponge farming to Jambiani? Why was Jambiani chosen?
4. Significant milestones in journey of the organization? (Key successes/challenges)
5. What is the connection between Switzerland and Zanzibar? Do you find any obstacles in terms of community attitudes, since MC is not originally from Zanzibar?
6. How does Marine Cultures compare to other NGOs in Zanzibar?
7. How are funds managed/ budgets created from



donations/membership fees etc.?

8. What advertising is implemented to promote members joining? Where are most of the members living?

(a) Do they visit MC or observe the projects?

9. Describe relationships with community members and partners and how they were established.
10. What does an NGO need to do to be sustainable after it leaves?
11. Has MC expanded recently? Why or why not?
12. What are some important lessons learned? Current challenges?
13. What are your goals for the future of the organization?

#### *10.1.2 Okala Mohammad, former Project Manager*

1. How and why did you become involved with Marine Cultures and how long did you work there? Why are you no longer working with them?
2. Describe history/story of establishing sponge farming in Jambiani.
3. What were the primary challenges and successes?
4. What was your original motivation to become involved in the sponge farming project?
5. What types of partners does Marine Cultures have and how do they work together? In your opinion how aware of MC and sponge farming are residents of Jambiani? Are tourists aware of NGO activities in Jambiani?
6. Has Marine Cultures grown in the past several years? Why or why not? How are the projects advertised, particularly to potential members? How are sponges marketed? How are funds and budgets managed?
7. In your opinion, how does an NGO get community participation?
8. What does an NGO have to do to be sustainable? How can it make a difference even after it leaves?

### **10.2 Appendix 2: Interview Questions for Sponge Farmers**

#### *10.2.1 General, for all farmers interviewed*

1. Describe the activities of a typical day.
2. When and how did you hear of Marine Cultures?
3. How long have you been farming?
4. What did you do before cultivating sponges? Do you continue?
5. Do you participate in other activities to generate income?
6. What are your responsibilities outside sponge farming? Is it difficult to balance them?
7. How much time do you spend each day you visit the farms?

8. How does farming benefit you? Is there social benefit? Are there useful skills you've learned?
9. What are the challenges of sponge farming?
10. What do men think about farming? Do you think they see you differently? Is it good to be independent?
11. What would you tell people unsure about starting to farm? Would you like to see more farmers?

#### *10.2.2 Follow-ups for bio-sketches*

1. Where did you grow up and how many siblings do you have?
2. Who do you live with now?
3. What do you like to do with free time?
4. What is something people should know about you?
5. What are a few significant events in your life?
6. What are some things you are proud of and why?
7. What is one important lesson you have learned?
8. Favorite food?

### **10.3 Appendix 3: Coral Project Interview Questions**

#### *10.3.1 Coral Farmers*

1. When and how did you hear of Marine Cultures? How long working with corals?
2. What did you do before corals? Do you continue?
3. Do you participate in other activities to generate income?
4. What are your responsibilities besides growing corals?
5. How often do you visit the farm?
6. How does coral restoration benefit you? Most useful skills?
7. What are the biggest challenges?
8. What do other people think about your work?
9. What would you tell people unsure about starting to farm? Would you like to see more farmers?
10. Where did you grow up and how many siblings do you have?
11. Who do you live with now?
12. What do you like to do with free time?
13. What are a few significant events in your life?
14. What are some things you are proud of and why?
15. What is one important lesson you have learned?
16. Favorite food?

#### *10.3.2 Boat Captain*

1. How and why did you become involved in the coral restoration project? Were you previously aware of Marine Cultures?
2. Are you interested in ocean conservation?
3. What were the positives of the Chumbe training? Any negatives?
4. What do friends and family think about coral restoration?

5. Did you have knowledge of coral before the training? What did you learn? Useful skills?
6. Do you think this will be a good source of income for you now and into the future?
7. How much time do you spend on the boat each day?
8. What are your other responsibilities?
9. How do you advertise?
10. Would you like to see more people become involved in the project?

#### 10.4 Appendix 4: Questions for Jambiani Neighbors

1. Do you know about Marine Cultures? How did you hear about it? What do you think about it?
2. Are you interested in learning more about Marine Cultures?
3. Have you seen/visited sponge farms?
4. How many sponge farmers do you know? Have you talked about it with them? Did speaking with them influence your opinion of sponge farming?
5. What is your current occupation/ job? Are you satisfied with your job?
6. What are the main challenges of your current job?
7. Do you know about growing corals? How did you know of it?
8. Are you interested in learning more about it?
9. Are you convinced to sponge farm? If not, what would convince you?

#### 10.5 Appendix 5: List of Participant Observations and Interviews

##### 10.5.1 Participant Observation:

- 11 Nov, 8:30am to 12pm, low tide at 9:30am, depth 1.5m; cleaned algae (*majani*) off sponges and familiarized with farms
- 14 Nov, 10am to 1:45pm, low tide about 11am; did more tending but in addition joined farmers for prep and putting stuff away
- 15 Nov, 10:30am to 1:30pm, low tide around 11:30am; cleaned sponges/ropes, learned how to plant and how to trim
- 16 Nov, 11:15am to 3:45pm low tide 12:12pm; maintenance, took pictures, took part in harvesting/ processing
- 17 Nov, 11:30am to 1:30pm, low tide around 12:50pm; visited other farms and spoke a bit with farmers, took more pictures, rinsed sponges ready for processing
- 25 Nov, 12pm to 2pm at high tide; observed deep water sponge nursery/ reef balls/ coral farm, saw cleaning of tables/ corals/ sponges and took pictures, not really participation so as to adhere to SIT's no diving policy

##### 10.5.2 Formal Interviews (Names were removed for privacy purposes, author has original names)

- 14 Nov, Sponge Farmers 1 and 2 (Aysha), experienced independent farmers, 45 min
- 17 Nov, Sponge Farmer 3, experienced independent farmer, 30 min
- 17 Nov, Sponge Farmer 4, soon to be independent farmer, 30 min
- 19 Nov, Okala Mohammad, age 44, former Marine Cultures project manager of 10 years, JAMABECO NGO, 90 min
- 22 Nov, 5 neighbor interviews, friends/family of farmers, 30 min each
- 24 Nov, Sponge Farmers 5 and 6, relatively new farmers, 1 hr
- 26 Nov, Sponge Farmer 7, relatively new farmer, 40 mins
- 26 Nov, Sponge Farmer 8, relatively new farmer, 40 mins
- 29 Nov, Sponge Farmer 2 (Aysha), 35 mins
- 29 Nov, Sponge Farmer 9 (Fatima), farmer of 3 yrs, 35 mins
- 29 Nov, Sponge Farmer 10 (Latifa), farmer of 3 yrs, 35 mins
- 30 Nov, Coral Farmer 1, 25 mins
- 30 Nov, Coral Farmer 2, 25 mins
- 30 Nov, Coral Farmer 3 (Juma), 25 mins
- 30 Nov, Boat Captain, 25 mins
- 3 Dec, Christian Vaterlaus, Marine Cultures managing director, 80 mins

##### 10.5.3 Informal Interviews

- 11 Nov, Ali Mahmudi, project manager, 3 months in position, in his 20s, conducted while cleaning sponges, mix of English and Kiswahili, communication throughout
- 15 Nov, Ali Pandu, coral farmer and sponge assistant manager of sorts, age 27, conducted in the field, mix of English and Kiswahili, also walked through village
- 25 Nov, brief conversation with Rolf Voorhuis, founder of Reef Care NGO about corals/ partnership with MC

Intermittent brief dialogues occurred throughout the study period with farmers, Marine Cultures staff, and Jambiani residents.

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