

Chumbe Island Coral Park an Eco-tourism Destination Responding to Challenges of Climate Change

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ABSTRACT

Tourism can play a decisive role in addressing climate change, as it is one of the world's largest economic sectors. Chumbe Island Coral Park in Zanzibar, Tanzania, is a leading example of a small eco-tourism enterprise with not-for-profit objectives that is managing and conserving the unique marine and terrestrial ecosystems of Chumbe Island, and both directly and indirectly responding to the challenges of climate change.

This paper describes the establishment of a full “no-take” marine sanctuary and a forest reserve on Chumbe that effectively reduces the anthropogenic threats to the area and promotes reef resistance, forest resistance and resilience in the face of climate change pressures. The mission of the company – to conserve the area for conservation and education purposes – has been considered at every step of the development process – from project conceptualization to lodge design, to staff recruitment and training, to tailored education programs and the promotion of wider entrepreneurial endeavors.

This paper highlights options for investment and management decisions, designs and technologies that exist for tourism developers to ensure that their investments help minimize (or at least avoid exacerbating) threats to the coastal environment and, consequently, threats to the communities dependent upon these coastal resources. Indeed, for the sake of sustainability and thus long-term profitability, tourism investments in coastal areas can no longer afford to ignore the particular challenges of climate change.

Keywords

Tourism, Eco-tourism, Chumbe Island Coral Park, Marine protected area, Private conservation area management

INTRODUCTION

As one of the world's largest economic sectors and an important part of modern society, tourism can play a great role in addressing climate change (Cabrini et al., 2008). Chumbe Island Coral Park in Zanzibar, Tanzania is a leading example of a small eco-tourism business with not-for-profit objectives that manages and conserves the unique marine and terrestrial ecosystems of Chumbe Island, and with this, both directly and indirectly responds to the challenges of climate change.

Chumbe Island Coral Park, Ltd. (CHICOP) was established in 1992 and opened for eco-tourism in 1998. From 1991-1994, CHICOP successfully negotiated with the government of Zanzibar that the western coral reef and forest on the island be gazetted as a park that would be managed and funded by the company.

The company purpose is “to manage, for conservation and educational purposes, the Chumbe Island Reef Sanctuary and the Forest Reserve. This is supported by eco-tourism activities which are directly related to the non-consumptive use of the natural resources.”

The company objectives are non-commercial, while operations follow commercial principles. Since 1995 CHICOP has been recognized as a privately managed marine protected area (MPA) in the World Database of Protected Areas (WDPA) and was, in 2000, also distinguished as a Member of the UNEP Global500 Forum.

The park includes the Chumbe Reef Sanctuary and the Chumbe Forest Reserve, a Visitors' Center and an Eco-Lodge on Chumbe Island. Management is based on consecutive Management Plans 1995-2005 and 2006-2016.

When the project started in the early 1990s, Zanzibar had no marine protected areas and no policy, legislation or institutions to manage them. Chumbe not only became the first MPA in Zanzibar and Tanzania, but also developed the first full “no-take zone” (NTZ) for marine conservation. This marine zone is permanently closed to all fishing activities and provides a vital refuge for biodiversity conservation, and a key site for fish and marine species to breed.

Permitted uses of the park include recreation (swimming, snorkeling and underwater photography), education and research. Extractive and destructive activities, such as fishing, anchorage, and the collection of specimens (even for research) are not allowed. Research is coordinated with the Institute of Marine Sciences, University of Dar es Salaam. A detailed monitoring program closely records all activities in the park and any infringements of park regulations have



Figure 1. The eco-bungalows on Chumbe Island. Photo by Oskar Henriksson.

been recorded and controlled since 1992. Rangers are permanently stationed on the island to patrol the no-take zone.

Tourism operations on the island started in 1998, and overnight capacity does not exceed approximately 5,000 visitors/year. Seven eco-bungalows are available for guests, and no further construction of overnight facilities is planned (**Figure 1**). Day visitation to the park is also closely regulated to ensure visitor numbers remain within the carrying capacity of the island. The Visitors' Center hosts a classroom for local schoolchildren, exhibits about the islands' marine and terrestrial ecology and a restaurant.

The Park rangers offer daily guided snorkeling tours in the Reef Sanctuary, and walks along inter-tidal, mangrove pools and forest trails.

Chumbe Island combines sustainable tourism with sustainable conservation area management. While most protected areas around the world are dependent on, and often short of financial support from governments or donor agencies, the revenue generated from small-scale but high-value eco-tourism on Chumbe Island provides for the park management and the conservation and education. Since 2000, CHICOP has been able to fully fund these efforts through the revenue from eco-tourism, and along the way has won many prestigious awards. About a third of operational costs are spent on conservation management staff and programs. Although a not-for profit venture, Chumbe is taxed like any other tourism enterprise, with no exemption or tax incentive for the conservation and education work done (Riedmiller, 2012 forthcoming).

Chumbe Island provides an exemplar model for tourism developers, investors and managers to ensure enterprises minimize climate change impacts and are sustainable in the face of climate change pressures.

RESPONDING TO THE CHALLENGES OF CLIMATE CHANGE

Protecting the Coral Reef from Climate Change

— Threats to the Coral Reef and Implications for Eco-tourism

Climate change is recognized as one of the greatest threats to coral reefs. The most serious and immediate phenomenon is coral bleaching (Obura & Grimsdith, 2009), which occurs when important symbiotic relationships in the coral community break down due to warmer water temperatures. Once stressed in this way coral communities turn white and can die within weeks.

Ensuring the integrity and survival of the coral reef environment is critical to the conservation of the Chumbe MPA, and is essential to maintain the very environment for which tourists are traveling, and paying money, to see. The sustainability of the program depends on the sustainability of the coral reef.

— Reducing Anthropogenic Threats through Creating and Actively Managing a “No-take” Marine-protected Area

There are two key properties that determine the ability of coral communities to persist and survive in the face of rising temperatures: their sensitivity and recovery potential (Obura & Grimsdith, 2009). A reef's sensitivity to stress can depend on many factors, i.e. the coral communities' dynamics, physical/chemical factors acting on the reef habitat and local conditions (such as crown of thorns starfish outbreaks, that can weaken the reef) (Obura & Grimsdith, 2009). A reef's resistance to such stress is its ability to remain relatively unchanged in the face of such a major disturbance, such as bleaching (Grimsditch et al. 2006)

Sensitivity to stresses, such as rising temperatures, can be greatly exacerbated when the reef is concurrently exposed to other stresses. Anthropogenic activities on coral reefs are a major cause of stress (Keller et al, 2009) and destructive practices (such as seine netting, dynamite fishing, etc.) considerably weaken a reef's resistance to climate change stresses (such as bleaching). Over-extraction of fish and other species (as occurs on most reefs worldwide) also exacerbates stress, as the removal of top predator fish (generally the most important species commercially) alters the reef-community dynamics, changing ecological relationships, and potentially leads to algal invasion on reefs and Crown-of-Thorns Starfish outbreaks. This in turn degrades the reef's ability to resist climate change pressures.

Therefore, a key management response to ensuring that a reef area maintains its integrity is the reduction of additional stress factors. Likewise a reef's recovery potential, or resilience to bounce back and recover after any stressful event (such as bleaching), is promoted greatly when anthropogenic threats are removed (Salm & West, 2003).

The establishment of a full no-take marine sanctuary at Chumbe effectively reduces the anthropogenic threats to the area and promotes both reef resistance and resilience in the face of climate change pressures. Maintaining strong ecological integrity in the area, and carrying out consistent monitoring of the reef sanctuary has been essential to managing climate change pressures (**Figure 2**). For example, this proved pivotal in the 1998 bleaching event that occurred globally, in which the Chumbe sanctuary suffered losses of only approximately 20% acroporus species, and showed considerable recovery within two weeks of the event, compared to other reefs around Zanzibar that suffered far greater proportional losses of reef species, with limited recovery.

By maintaining the reef's resilience in this way, key benefits are ensured, not only for the sustainability of the enterprise but also for local fishers, including food security and biodiversity conservation.

— Chumbe Helps Restock Locally Depleted Fisheries and Promote Recovery of Degraded Coral Reef Ecosystems

Chumbe Island is located upstream of the most important fishing grounds opposite Zanzibar town. The sanctuary provides a protected breeding ground for fish, corals and other species, which “spill over” to re-colonize nearby over-fished and degraded areas.



Figure 2. The very healthy and resilient reef at Chumbe Island. Photo by Oskar Henriksson.

As the predominant ocean current in the Zanzibar channel is northerly, larvae of corals and other marine organisms as well as juvenile and adult fish tend to migrate to the northern heavily fished reefs.

Studies into fish-size-frequency-distribution patterns show that fish are achieving significantly greater size inside the reserve (Tyler, 2005). The presence of these larger, older fish promotes greater exponential breeding and increases in biomass, leading to the spillover effect (Hughes, 2007). Qualitative studies have shown that 83% of fishers report perceived greater catches proximal to the MPA due to this spillover effect (Tyler, 2005).

Chumbe contributes to biodiversity conservation and ecological restoration, by effectively protecting a coral reef, which has at least 90% of the scleractinian coral species recorded in East Africa (Veron, pers.com.1997). The Chumbe Reef Sanctuary has become refuge for the critically endangered Hawksbill Turtles and a proactive Crown-of-Thorns Starfish (COTS) removal program is also undertaken whenever invasions occur, further reducing stress to the reef environment.

The sanctuary is a hot spot for seagrasses, as it hosts seven out of the 13 species known from the region (Bandeira and Björk 2001; Knudby & Nordlund, 2010). In Zanzibar, invertebrate harvesters have observed or experienced a decline in animal abundance and seagrass cover over the last two decades, and this is a pressing problem in the Western Indian Ocean (WIO), where many of the livelihoods of local people are immediately dependent on invertebrates collected from seagrass beds (Nordlund et al., 2010). The

Chumbe No-take Marine-protected Area is also a safe haven for less-known flora and fauna typical of inter-tidal reef flats that are little researched.

Promoting a Robust Forest Habitat in the Face of Climate Change

— Threats to the Forest and Potential Impacts on Eco-tourism

Climate change also threatens terrestrial environments in a number of ways. Some areas may experience more frequent and more extreme storms, lower precipitation levels and increased evaporation rates. Such threats can impact forest habitats, create changes in soil (e.g., moisture levels, erosion and acidity) and cause loss of habitat cover through landslides and patch exposure from fallen trees. Such conditions also pose a threat to the health and safety of tourism operations in forest habitats (Cabrini et al., 2008).

— Reducing Anthropogenic Threats by Creating a Forest Reserve

Like the marine environment, the forest environment is at its most robust when other threats are removed. Land clearing, for example, opens up forest areas to the impact of severe weather, causing loss of topsoil and soil integrity that is normally maintained by the complex root network of robust forests. Pollution, the use of agrochemicals and habitat fragmentation also lead to reduction of biodiversity and habitat strength in the face of climate pressures.

On Chumbe Island the coral rag forest habitat (i.e. tropical semi-arid forest on fossil coral) is fully protected as a gazetted forest reserve. The forest is dense with solid canopy cover and home to the world's largest known population of the red listed Coconut Crab (*Birgus latro*; Hartnoll, pers.com. 2000). The forest is monitored, and its biodiversity maintained, whilst other coral rag habitats in Zanzibar suffer from felling and reduction in habitat cover and diversity.

Invasive species are another threat encouraged by anthropogenic factors, including climate change. Like many formerly inhabited islands, rats (*Rattus rattus*) were a serious pest on Chumbe Island at the start of operations – threatening bottom-breeding bird species, reptiles and other species, and leading to habitat degradation and biodiversity loss. CHICOP successfully eradicated rats in 1997 and since then closely monitors to prevent re-infestation. Through this active intervention, the pristine Chumbe forest biodiversity was restored and now remains in prime condition.

Such undertakings have encouraged further biodiversity conservation initiatives, including, in 1998, the translocation of the critically endangered mini-antelope Aders' Duiker (*Cephalophus adersi*), from its diminishing range on mainland Zanzibar to the secure sanctuary on Chumbe Island. Here it has become established and started breeding. The undisturbed Chumbe Island also supports the successful breeding of rare migrant birds, e.g. the red listed Roseate Tern (*Sterna dougalli*).

Eco-architecture: Building for Sustainability

— Threats From, and To, Coastal Development, and the Implications for Eco-tourism

The development of coastal tourism infrastructure can both increase the overall vulnerability of a coastline (and other coastal infrastructure) to climate change impacts and be vulnerable to conditions caused by climate change.

In tropical areas, threats from coastal tourist development include pollution caused by operations (such as sewage run-off, solid waste going into the sea, etc.) and these can all have negative effects on a coral reef environment. Consequently, the threats to coastal tourism development from climate change are exacerbated. Increased frequency and intensity of storms and wave surges created by climate change are already an anticipated threat to coastal infrastructure. Where a coral reef is damaged, the wave surge breaks closer to shore and can cause dramatic erosion of the beaches and coastal land areas.

Other threats to coastal tourism include the potential damage to infrastructure caused by increased intensity of storms, flooding and damage to historical, architectural and cultural assets, increased rainfall rates in some areas and, conversely, increased evaporation rates and reduced water availability in other areas. This latter issue can lead to competition over fresh water sources, both between tourism developments in any one area, and between tourist developments and local population needs.

Add to this the potential threat of sea-level rise (that is anticipated through climate change) and it becomes clear that the challenges of climate change need to be considered at all stages of a coastal tourism development process (from design, planning and management), including the importance of maintaining the integrity of the surrounding marine and coastal environment for the sustainability of any tourism investment.

— Chumbe Island's Eco-architecture and Infrastructure Adaptations

To effectively ensure that the tourism development on Chumbe does not cause any threats to the surrounding marine and coastal environment, Chumbe has, from its outset, been committed to ecologically sustainable architecture and operations that have close to zero impact on the sensitive terrestrial and marine ecology of the island.

In addition to this, all buildings are situated at least four meters (vertically) above the high-tide mark (from the highest spring tides), and are set back from the beach to avoid potential damage from storm surges and coastal erosion. The buildings are also positioned to channel winds in line with the predominant seasonal wind directions, reducing stress on the bungalow architecture and providing natural air-conditioning (reducing any need for energy-consuming air conditioning).

Reducing threats to the surrounding environment:

Vegetative Gray-water Filtration. To avoid introducing pollutants from wastewater (or gray water) from showers, washbasins and the kitchen, all wastewater is passed through a

particulate filter (and series of grease traps for the kitchen water) before entering a specialized vegetation bed that absorbs large amounts of phosphates and nitrates before clean water is released.

Composting Toilets. Sewage is totally avoided by using composting toilets that also avoid any fresh water consumption. The anaerobic composting process of these toilets turns human waste into nutrient-rich dry matter, which is reduced to a sixth of its original volume and can in turn be re-used as fertilizer and compost mulch.

Management of Other Waste. Organic kitchen waste is also recycled to provide the compost for the toilet systems. Fresh-food products purchased on open markets avoid the acquisition of non-biodegradable products, in particular food packaging. Any other waste that cannot be recycled or composted is removed from the island.

Solar Power for Light, Communication and Water Heating. As climate change is caused by the increased CO₂ in the atmosphere through the burning of fossil fuels, photovoltaic panels generate all electrical energy on Chumbe Island, while solar water-heaters provide warm water for showers. These ecologically sensitive technologies effectively save energy and reduce all pollutant emissions from the eco-lodge.

Use of Local Building Technologies and Materials. All buildings on Chumbe Island reflect local architectural low-energy and low-input traditions, cultures and technologies, reducing the site's carbon footprint and, by giving preference to local products and technologies, also creating a thriving market for local producers.

Rainwater Catchments. With no groundwater available on the island, all buildings have been designed to make maximum use of rainwater that is collected by palm-thatched roofs and filtered through combined gravel and sand filters. The water is then stored in the large cisterns under the floor of each building to provide for water needs year round.

Promoting Social Resilience to Climate Change

Social resilience, much like biophysical resilience, is the ability of a system to recover after a stressful event. The system, in this instance, is society itself – the communities living in and around coastal areas who are vulnerable to the impacts of climate change. Threats to these societies from climate change include, for example, injury and loss of lives, properties and livelihoods from flooding, and from increased frequency and intensity of storms.

However, low resilience to these climate change factors can be socio-economically driven, such as absence of support systems in the face of disasters, low awareness of potential threats or necessary preparatory actions and no plans to mitigate impacts, low savings to help families through difficult times, and unreliable or lacking employment opportunities to enable self-dependence in planning and preparing for any potential event. This can also be considered a population's “adaptive capacity” to cope with climate change effects (Berkes & Jolly, 2001) and in areas already afflicted by high rates of poverty, these added challenges can cause social unrest and conflict (Reck, 2008). When

coupled with a degraded environment from other, non-climate change stressors, these threats are further exacerbated, such as reduced in-situ food security from reduced fisheries stock and a lack of awareness on methods to mitigate coastal erosion and manage sustainable fisheries continues to compound the challenges that will be faced.

Responses to such events can depend on many factors, including the social capital (or ability for collective action) of communities, and studies have shown that coastal communities with such social capital are more resilient to disasters (Adger, 2003).

Chumbe Island's mission to conserve the Reef Sanctuary and Forest Reserve for conservation and education purposes supports social resilience to climate change on a number of levels.

— Environmental Education and Awareness Raising

Education programs on Chumbe Island are targeted at a range of sectors in the community – from fisher groups to schoolchildren to government personnel.

Community-education Programs. Since the start of operations on Chumbe Island, thousands of community members have participated in a range of activities to promote public awareness about the need for sustainable management of coastal resources and issues related to climate change. Through a community outreach program CHICOP has also trained 25 representative “peer educators” from ten villages around southern Zanzibar, who educate their fellow villagers on environmental issues, including measures to mitigate and be resilient to climate change.

Fisher-education Programs. Chumbe helps create awareness among fishermen in a range of ways. The Chumbe rangers manage the reef sanctuary through educative enforcement methods, sharing with fishermen information about the nature of coral reefs, the purpose of the MPA as a breeding ground for fish and the importance of marine conservation for sustainable coastal management. The park rangers, former fishermen themselves have also trained fisher representatives, and this has resulted in fishers voluntarily complying with the regulations for the no-take reef sanctuary, to protect their fishery stocks, and a far greater awareness of the impact of non-sustainable activities in reducing coastal resilience.

School-education Programs. School education in Zanzibar, as elsewhere in the region, is based on rote learning of an extremely academic syllabus having little



Figure 3. Khamis Khalfan is introducing snorkeling to Zanzibari school children. This is a unique learning opportunity for girls since Zanzibar is a predominantly Islamic country where the dress code for women is very conservative and as a result, women do not learn how to swim. The Environmental Education Program encourages schoolgirls to learn how to swim and snorkel across in coral reefs in appropriately conservative clothing.

relationship with the immediate surroundings. Though Zanzibar is a coral island, coral reef ecology and coastal management is insufficiently covered in school syllabi. Extra-curricular activities, such as field excursions are rarely organized and very few children have a chance to visit reefs and tropical semi-arid (coral-reef) forests.

Chumbe's school program provides an excellent opportunity for hands-on learning for both students and teachers from Zanzibar and other parts of the world (**Figure 3**). CHICOP implements Education for Sustainable Development (ESD) through an Environmental Education (EE) program. This program has since 1995 welcomed more than 5,000 students and 800 teachers for one-day school excursions to Chumbe Island.

Nature trails and educational materials (in Kiswahili and English) have been developed about the forest and the reef, and the excursions offer environmental hands-on education for schoolchildren, at the same time as giving teachers ideas for how to conduct field-based activities related to marine biology, forest ecology, biodiversity and climate change. Chumbe has also helped establish environment clubs in schools and communities across Zanzibar, who are addressing issues such as waste management, biodiversity loss and climate change mitigation projects such as tree and mangrove planting activities.

— **Institutional and Governmental Capacity Building**

Chumbe contributes to capacity building of government staff. From the beginning in 1991, more than seven government departments were involved with important issues concerning the establishment and management of the reserve. An advisory committee with representatives from government departments, research institutions and local community leaders has been in place from 1995, and through this, the group receives considerable capacity building and awareness raising on the various programmatic issues.

Cross-institutional training has also been given on a range of projects, such as rat eradication programs (to maintain healthy island forest habitats), to training of rangers in other emerging MPA's and coastal conservation programs across the region.

In addition to this, all staff members on Chumbe, sourced predominantly from communities proximate to the MPA, receive training in all aspects of the work – no matter their position on the project. This includes training on basic marine and coastal ecology, eco-technologies, such as rainwater harvesting, and sustainable waste management practices, such as composting, recycling and handling solid and hazardous waste appropriately.

— **Promoting Employment and Entrepreneurial Opportunities**

The promotion of social resilience and social capital is also supported through the employment of 42 local people on Chumbe, each with an average of 12 dependents. As a fully managed nature reserve, and also due to the particular eco-technologies chosen, CHICOP is very labor-intensive. A third of the staff of 43 employees are directly involved in conservation management and education.

With only seven rooms, CHICOP has probably the highest employee/room ratio of any tourism business in Tanzania, and, according to a study of the International Finance Corporation, three times the international average for eco-lodges (IFC, 2004). In addition, numerous entrepreneurial opportunities have been enabled as the park has received a steadily increasing flow of visitors. The considerable international publicity Chumbe has gained with the many prestigious international awards for environmentally and socially responsible tourism has helped to market Zanzibar as an attractive eco-tourism destination, and as a consequence created wider employment opportunities. These include makuti palm thatch producers, taxi drivers, boat handlers, a women cooperative making biodegradable organic soaps and other products.

In addition to this, the project is yielding many insights for coastal management practices, and for solving the problem of financial sustainability in the management of protected areas in Zanzibar and elsewhere. The experiences are contributing to the development of a sustainable protected areas system in Zanzibar and the region.

CONCLUSION/SUMMARY

This paper highlights the ways in which one eco-tourism destination, Chumbe Island Coral Park, in Zanzibar, Tanzania, has pro-actively responded to the challenges of climate change. It can be seen that considerations of climate change, and development of eco-tourism operations that promote long-term sustainability and achieve the mission of the project – to conserve the area for conservation and education purposes – have been considered at every step of the development process – from project conceptualization, to lodge design, to staff recruitment and training, to tailored education programs and the promotion of wider entrepreneurial endeavors.

This shows us the possibilities that exist for tourism developers to ensure their investments are conducted in such a way as to minimize (or at least avoid exacerbating) the threats to the coastal environment and, consequently, the threats to the communities dependent upon these coastal resources. It also shows us steps for preparedness that eco-tourism planners may consider – to ensure their investments are able to adapt to increasing pressures and threats from climate change events.

Finally, and of perhaps greatest importance, it highlights the inter-connectedness of the coastal environment – its people, its environment, its biodiversity – and the importance of understanding all of these elements in order to truly prepare for the challenge that climate change presents.

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