

Chapter 4

Territory, Economy, and Demographic Growth in São Tomé and Príncipe: Anthropogenic Changes in Environment



Xavier Muñoz-Torrent, Ngouabi Tiny da Trindade, and Signe Mikulane

Abstract Nearly five centuries of human presence on the islands of the Gulf of Guinea have considerably marked the landscape with the replacement of natural habitats by *roças* (plantations) and other settlements, the introduction of numerous exotic plant and animal species, and the exploitation of resources needed for urban construction and daily life of the growing human population. Exponential population growth and, consequently, the urban sprawl are resulting in deforestation, illegal beach sand mining, exhaustion of natural resources, expansion of non-endemic species, and extermination of the endemic ones, thus causing immense resource exploitation and rapid environmental deterioration. The absence of an effective territorial planning amplifies the island's vulnerability and increases the fragility of the ecosystems, posing clear threats to the islands' unique biodiversity.

Keywords São Tomé and Príncipe · Biodiversity · Demographic growth · Economy · Environmental impact · Insularity · Environment-society interactions

Gulf of Guinea Oceanic Islands: A Biological Laboratory of Landscape Alteration

In the context of the European expansion, African islands in the Atlantic were prime spaces for experimentation of new agricultural species (Ferrão 2005). Since the early period of the European Age of Expansion, and especially for the Portuguese

X. Muñoz-Torrent (✉)

Servei d'Estudis i Observatori de la Ciutat de Terrassa, Terrassa, Catalonia, Spain

Associação Caué—Amigos de São Tomé e Príncipe, Barcelona, Catalonia, Spain

e-mail: xavier.munoz@saotomeprincipe.eu

N. T. da Trindade

Instituto Nacional de Estatística de São Tomé e Príncipe, São Tomé, Sao Tome and Principe

S. Mikulane

BIM Institut (Interdisziplinäres Institut der Fachbereiche Architektur, Bau- und Umweltingenieurwesen und Geodäsie), Hochschule Bochum, Bochum, Germany

© The Author(s) 2022

L. M. Pires Ceriaco et al. (eds.), *Biodiversity of the Gulf of Guinea Oceanic Islands*, https://doi.org/10.1007/978-3-031-06153-0_4

Colonial Empire, these islands became biological laboratories for the acclimatization of different economically interesting plants and animals from Europe and Africa, and even later from South and Central America and Asia. Initially, the most basic need for maritime expansions was the creation of safe ports for transoceanic trips, where horticultural commodities could restock the ships. The Gulf of Guinea Oceanic Islands served as a strategic base for the European colonial enterprise, especially because the islands of Príncipe, São Tomé, and Annobón were uninhabited (e.g., Seibert 2004). Here, we describe the history of the relationships between the human societies that inhabited these islands and their surrounding environment, with a focus on the island of São Tomé from which the most information is available.

According to the existing historiography, Portuguese navigators were the first humans to reach and colonize the oceanic islands of the Gulf of Guinea. São Tomé and Príncipe islands were discovered by the Portuguese navigators João de Santarém and Pêro Escobar on December 21, 1470, and January 17, 1471, respectively. The island of Annobón was discovered on January 1, 1473, by the Portuguese navigator Fernão do Pó who was attempting to find the maritime route to India. After a previous failed colonization attempt, in 1486 the Portuguese military leader Álvaro de Caminha became the third “donatário” (governor) of São Tomé and promoted the first successful colonization of São Tomé, establishing a small village in the area around Ana Chaves Bay, in the north-eastern part of the island (Seibert 2015). The original settlers included Europeans consisting of volunteers, exiles, and a group of Jewish children, as well as Africans, most of whom were enslaved (Seibert 2015). The island of Príncipe would only start to become populated in the early sixteenth century (Seibert 2015), and Annobón decades later, in 1592.

From these initial settlements until the mid-nineteenth century, the main economic activities of the islands were linked to the slave trade, in which the islands functioned as an important entrepôt for the transatlantic trade (especially until the mid-seventeenth century). The islands were also transformed by extensive sugarcane monoculture plantations (mainly throughout the sixteenth century), especially in the northeast of São Tomé (Seibert 2015). By the mid-sixteenth century, the island of São Tomé was the world’s main producer of sugar, but the development of sugarcane cultivation in Brazil led to the collapse of São Tomé’s plantations by the beginning of the seventeenth century (Seibert 2015). Revolts by enslaved Africans also contributed to this decline, such as those led by the iconic King Amador in 1595 that devastated a considerable number of sugar mills (Seibert 2015). With the end of the large sugarcane plantations, the islands’ economy was reduced to the production of supplies to be sold to the ships that docked there. Many of these were linked to the slave trade, which was limited in 1836 and completely banned with the abolition of slavery in São Tomé and Príncipe in 1875, when enslaved plantation workers transitioned to a subsistence wage labor model (Seibert 2015).

Despite the impact of sugar mills on the local landscape, the human population during this early period was considerably low, with a total of 12,672 people on the islands of São Tomé and Príncipe in 1758, of which only 53 were white Europeans (Seibert 2015). From the second half of the nineteenth century onward, the islands would witness the rapid expansion of coffee and cocoa crops, which came to

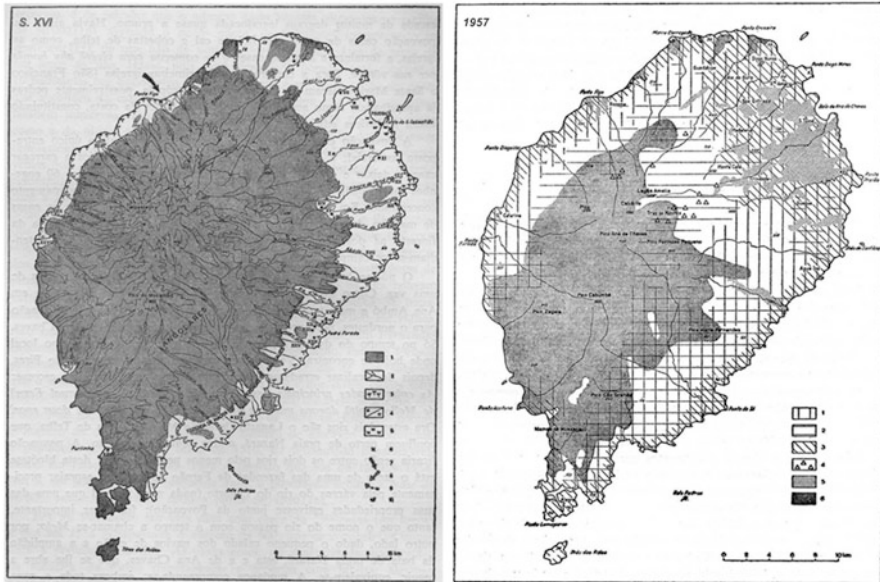


Fig. 4.1 Evolution of land occupation in São Tomé Island from the late sixteenth century (left: 1 *Obô*—forests, 2 sugarcane plantations and fields, 3 coconut palm and banana, 4 factories and sugar mills, 5 wetlands) to 1957 (right: 1 cocoa, 2 coffee, 3 oleaginous trees, 4 quinines, 5 quintal cultures, family horticulture, 6 *Obô*—forests). The diminishing cover of the *Obô* (dark gray area) is evident. Tenreiro (1961)

dominate the economy and landscape through the establishment of dozens of *roças* (plantations and their dependencies; Seibert 2015). According to available historical data, cocoa plantations in 1913 occupied about three-fourths of the surface of São Tomé and Príncipe islands, a proportion that would gradually start to decline after the First World War, due to the infestation of cocoa trees by pests, soil erosion, and expansion of cocoa cultivation in other regions (Seibert 2015). This decrease in cocoa cultivation was such that by the time São Tomé and Príncipe became independent in 1975, the total planted area was only one-fourth of the country's territory (Seibert 2015). Nearly five centuries of human presence on the islands have considerably marked the landscape with the replacement of natural habitats by *roças*, the introduction of numerous exotic plant and animal species, and the exploitation of resources needed for urban construction and daily life of the growing human population.

Similar to other Atlantic islands off the coast of Africa, the recent ecological and landscape history of São Tomé and Príncipe is strongly linked to the growth of human activity, including the degradation of native ecosystems and the establishment of alien species. This process was strongly associated with cycles of agricultural development, initially the production of sugarcane, and then coffee and cocoa (Eyzaguirre 1986—Fig. 4.1). Cocoa in particular was decisive for the economic development of the islands, with regressive stages leading to the generation of

secondary forest, or scrub, which emerged mainly as a result of agricultural abandonment. More recently, ecosystems continue to be altered, namely by the installation of extensive areas of oil palm monoculture (Oyono et al. 2014).

By the end of the 1950s, the geographer Francisco Tenreiro noted that the original forests of São Tomé were no longer found below 1400 m altitude and thus that only 1/140 of the total land on the island was covered by the original vegetation. He denounced that “by clearing the woods, degrading spontaneous formations, even replacing them entirely with new formations, men almost completely transformed the primitive physiognomy of the island” (Tenreiro, 1961; Fig. 4.2). These dramatic changes had pronounced impacts on the islands’ biological diversity, adding several alien species (Muñoz-Torrent 2013) and likely eradicating many natives ones. Landscape transformations were associated with the process of developing human settlements, such as the drainage of swamps, the creation of dams and canalization of river courses, the construction of buildings and roads (especially on the coastal fringes), and overexploitation of natural resources, both on land and at sea. Some species were directly targeted for extirpation, such as attempts to eradicate species that transmit diseases like the tsetse fly (Costa 1913) and more modern attempts to eliminate malaria. These eradication campaigns employed methods including deforestation, draining swamps, and harsh chemicals that likely contributed to significant ecological loss. Thus, the presence of humans on the islands from the early colonization to the present day has dramatically shaped the landscape and ecosystem ecology.

In São Tomé, Tenreiro compared landscape units to reconstruct the changes that occurred throughout the island’s colonization history: from the closed forest of the *Obô* (Creole term referring to the original forest, called *Obô jiji* when it is dense and impenetrable) to the sugarcane fields (which emerged in the sixteenth to seventeenth centuries), passing through secondary forests and plantations of cocoa, coffee, oilseeds, and bananas (which emerged from the nineteenth century onward). The intensive agricultural use resulted in the gradual impoverishment of soils, giving rise to a savanna area in the north of São Tomé that is dotted with palm groves, riparian forests, and *micondos* (local name given to baobab trees) (Fig. 4.2—Diniz and Matos 2002; Figueiredo et al. 2011).

Despite these landscape alterations, the first impression of those arriving to the Gulf of Guinea islands is lush rainforest, which in some places reaches the coastline giving the landscape an appearance of dense and untouched forest, almost limitless (Fig. 4.2a). That first impression gives contemporary visitors the idea that they are in front of the original landscape of the *Obô*, never altered. The reality, however, is that plant diversity across the landscape varies not only as a function of climate, relief, and soils, but also as a function of the history of human occupation and, in particular, of the different plantation regimes that existed on the islands. These islands clearly illustrate the consequences of an incessant landscape modification: how demographic expansion and economies based on intensive cash crop monocultures and forest cultures impact the climate, environment, and biodiversity. Thus, addressing contemporary environmental challenges must account for the reality that the landscape is fundamentally different than it was 500 years ago and the biological

Fig. 4.2 The different processes that modified the São Tomé landscape, from the original humid jungles to drier savannahs with *micondós* (baobabs) and palm groves. Top: the mountainous and more humid regions that preserve dense forests (photo © Rogério Nave—2003). Middle: the most intense deforestation in the coastal and drier areas of the island, which reached its first peak between the late nineteenth century and early twentieth century. In the photo, corn plantation fields among coconut palm groves (photo © Orlando Ribeiro—1955). Bottom: drier area of the northern parts of the island, which currently presents a very modified vegetation, as is the case of the human-made savannahs (photo © Thomas Schenk—2007)



communities now include many introduced species that have since become acclimated.

Furthermore, even for those with a deep understanding of landscape richness and biological diversity, the impression of leafiness, of dense forest which is stubbornly resisting to humanization, induces a misleading perception about the islands' dimensions, making them bigger than they really are. Therefore, when addressing

environmental issues, both the original vegetal landscape, that most Santomean people never stepped on, and also the current landscape constituted mainly of non-native species must be taken into account. In other words, when we are talking about ecosystems and biodiversity of the Gulf of Guinea Ocean Islands, biological and landscape evolution has to be regarded in a wider sense, considering also the adaptation of introduced species and not only the endemic ones, although, in any case, the latter are those which distinguish the islands' ecologic richness.

Despite the intense landscape transformation experienced since the first human settlements, the diversity of both plant and animal species that can only be found on these islands is extraordinary. The latest report on the biodiversity of São Tomé and Príncipe states that 15% of the vascular plant species catalogued on the islands are endemic, while 57% of birds in São Tomé and 54% in Príncipe, 44% of reptiles, and 100% of amphibians are also endemic (MIRNASTP 2016). However, many of the species presently found on the islands were introduced, constituting an important source of products that make up the traditional basic diet of the population, as well as their housing (wood) and energy source (firewood and charcoal). Likewise, agricultural crops are non-native and are a key driver of the national economy, both in terms of the domestic and export markets (Oliveira 1993).

This is especially important considering the exponential growth of the population in recent decades and also the projected growth for the decades to come, which, following the improvement in living standards, will certainly continue to intensify territorial uses and result in further landscape changes. Future risks include further deforestation due to increased demand for building materials and agricultural production, and depletion of fisheries and other natural resources. Accelerated growth, which is often poorly planned and rarely monitored, constitutes a real—and in some cases already imminent—threat to the islands' extraordinary biological richness and the people who rely on the ecosystem services they provide.

Demographic Growth, Territory, and Urban Sprawl

Until the 1960s, 32% of the up to 65,000 inhabitants of São Tomé and Príncipe lived in the Mé-Zóchi district (in the center of the island), where many of the most populated agricultural fields were concentrated (INESTP 2012a). From 1970 onward, the distribution of the population began to change, with the district of Água Grande becoming the most populous. This is where the capital city, São Tomé, is located, and this change in distribution clearly reflects the decline in the plantation economy and the trend toward urbanization. There was also an inversion in the structure of the resident population, which became female-biased. This phenomenon was due to the reduction of men brought to work in the fields and emigration of men searching for better working and living conditions abroad. Meanwhile, with the proclamation of independence in 1975, thousands of people left the country, including many of the most educated and prominent members of society. At the same time, many of those who had left in search of better

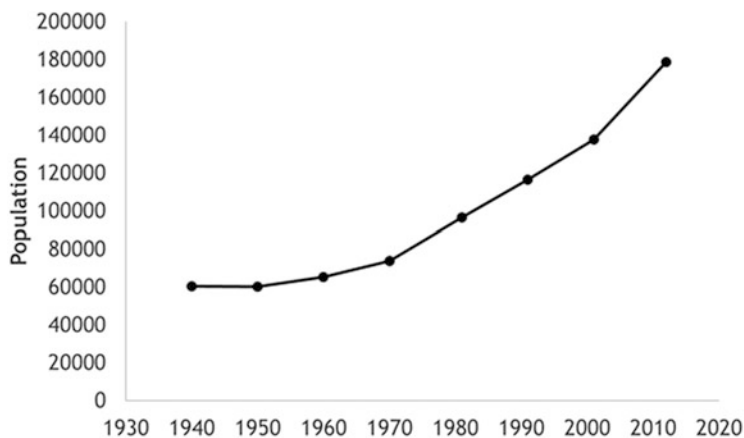


Fig. 4.3 Human population growth in São Tomé and Príncipe (source: INESTP 2012a)

opportunities abroad began to return to São Tomé and Príncipe due to the war in Angola. Comparing immigration and emigration around the time of independence, it appears the population grew, and became more concentrated around the capital city and other urban centers. Data from the last Portuguese census, in 1970, and from the first censuses of independent São Tomé and Príncipe illustrate these changes (Fig. 4.3).

Between 1976 and 1991, the colonial infrastructure was largely intact and in full operation, and the majority of the population remained in the rural areas, where the *roças* constituted authentic autonomous villages. Drops in production from former plantations, associated with the depletion of trees and production resources, together with increased competition and lower prices on the international cacao market, resulted in a collapse of the economic structure. Many of the agricultural companies that had become nationalized after the independence were privatized again, but most of them failed and became abandoned, intensifying the regression of intensive crops and the expansion of capoeira areas (scrubs, shrubby habitat). In 1981, the general population and housing census reported 96,566 inhabitants in the country, representing an increase of 30.8% compared to 1970. In the following decade, this rate of growth dropped to 20.6%, to reach a resident population of 116,504 inhabitants in 1991. It was during this period that the rural exodus toward the urban centers of the country further intensified, in particular to the outskirts of the city of São Tomé, resulting from the agrarian reform financed by the World Bank (INESTP 2012a). Between 1992 and 2020, there were two censuses, one in 2001 and the other in 2012 (INESTP 2012a). Between 1991 and 2012, the population increased by 53.41%, to 178,739 people, an increase of 62,235 inhabitants in just 21 years and almost double the population at independence. The average annual growth rate between 2001 and 2012 was 2.45%. At the district level, this index reveals that Lembá had the highest growth rate (2.96%), followed by Água Grande (2.74%), while the lowest was Caué (0.86%). These values illustrate the trend toward

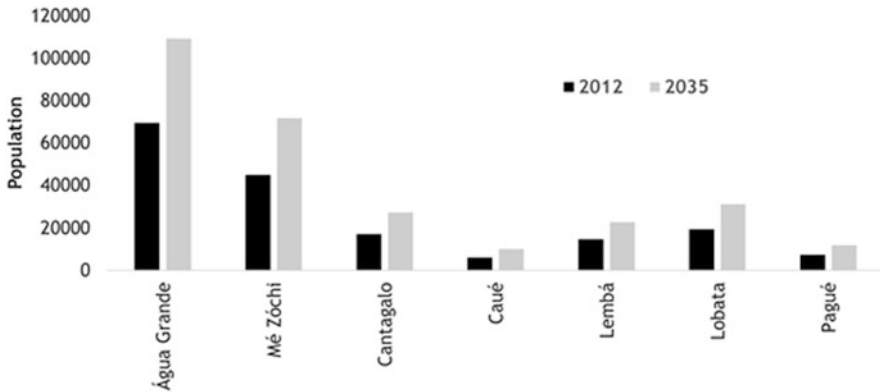


Fig. 4.4 Distribution of São Tomé and Príncipe population in each district (2012 and projections for 2035) (Source: INESTP 2012a)

population concentration around urban areas, especially around the São Tomé-Trindade axis, as seen in recent studies.

Average growth rates make it possible to carry out population projections to better understand demographic dynamics and design a more realistic territorial planning. Between 2012 and 2015, the annual population growth was 2.03%, and between 2012 and 2025, annual population growth is projected to be 2.08%, and 2.01% from 2025 to 2035. Consequently, population growth is projected to be approximately 26% between 2012 and 2035, which would place the total population at 284,293 inhabitants by 2035 (INESTP 2012c).

The demographic increases have taken place mainly in the suburbs of urban areas. In the 1990s, the number of agricultural workers, most of them residing in farmland and other rural areas, decreased from 14,500 to 8860 (INESTP 2012b). This trend was likely in response to the agrarian reform promoted and financed by the World Bank, which encouraged the government to dismantle large plots of land. These were divided into small parcels and distributed among 8735 former agricultural workers, under a usufruct regime (Oliveira 1993). The implementation of this policy had perverse effects on urban centers, namely in conditioning the capacity and sustainability of the country's current structures and basic services, increasing its population density, and clearly unbalancing the distribution of the population across the national territory (Seibert 2015). However, this trend is expected to be attenuated in the near future: if in 2012 67% of the population lived in urban areas, in 2035 it is estimated that it will reach only 70% (INESTP 2012c). The rural exodus reached its greatest extent in 1991 with the land reform, but it did not stop and has only decreased in intensity. The extreme poverty of rural areas was the main reason for this exodus, forcing populations to move in search of better living conditions, which resulted in the saturation of urban areas. It is estimated that 38.9% of the population will reside in the district of Água Grande by 2035, where the capital is located, and that by then its population will exceed 100,000 inhabitants (INESTP 2012a—Fig. 4.4). The rapid emergence of high population densities concentrated around a

few urban areas has created several environmental problems, with clear implications for human well-being, such as intense road traffic and high concentrations of noise, light, and chemical pollution, as well as a deregulation of urban expansion and exploitation of resources, with far broader environmental implications.

Several indicators already point to a “demographic transition” (see Thompson 1929) in São Tomé and Príncipe. The large difference between high birth rates and low mortality rates provides a marked growth, which explains the observed rapid demographic expansion. On the other hand, the exacerbated increase in urban development, the widespread use of contraceptive methods, the evident appearance of women in the formal employment market, the costs associated with educating children, the improvement in the level of education, and the increase in family planning point to a reduction in the birth rate, which will soon approach the death rate and lead to the stabilization of the population. Other demographic indicators reveal these same trends: the average age of the population will go from 19 years old in 2012 to 26 years old in 2035 and the time needed for the population to double will go from 35 to 38 years. In any case, despite the trend of the main demographic indicators, the population of São Tomé will maintain a high population growth rate, and it is estimated that it will reach a synthetic fertility rate of 2.01 in 2030.

The districts of Água Grande, Mé-Zóchi, and Lobata, in the north of the island of São Tomé, have three-fourths of the national population, despite corresponding to less than one-fourth of the country’s area (INESTP 2012a). The highest density in 2012 was in the district of Água Grande, with 4209 inhab./km² in 16.5 km². At the opposite extreme, was the district of Caué, with 23 inhab./km² in 267 km², illustrating the great territorial imbalance in terms of population distribution, which also affects the available services and the type of economic activity in each region. Since 2001, the entire district of Água Grande has been considered urban, which homogenizes the analyses referring to the capital, although it is clear that some regions within this district maintain elements of rurality. In the 2012 census, population distribution was georeferenced for the first time, which will constitute an important tool for understanding its evolution (Fig. 4.5). The urban expansion is very evident, using as main axes the national roads that leave the capital, connecting it with residential neighborhoods in Trindade to the west, in Santana to the south, and several villages in the north, toward Guadalupe. This trend is particularly evident along national road 3, from the neighborhood of Madredeus and industrial areas in Água Grande to the village of Trindade and beyond in the district of Mé-Zóchi, which effectively constitute an urban continuum. This expansion entails an increasing urban sprawl, the impacts of which are especially significant because the Santomean residential tradition is not compact, consisting mainly of detached single-family houses built of wood on family plots, known as *quintais*.

Between 2012 and 2035, the rural population is expected to continue to decline, in contrast to urban population growth. Underlying these trends is an increase in the territory’s vulnerability, especially given the scarcity of effective regulatory instruments that control urban expansion and the use of natural resources. In other words, the population is becoming even more urban, reaching 70% of the total population in 2020, which will especially affect the forecast of needs for basic services and

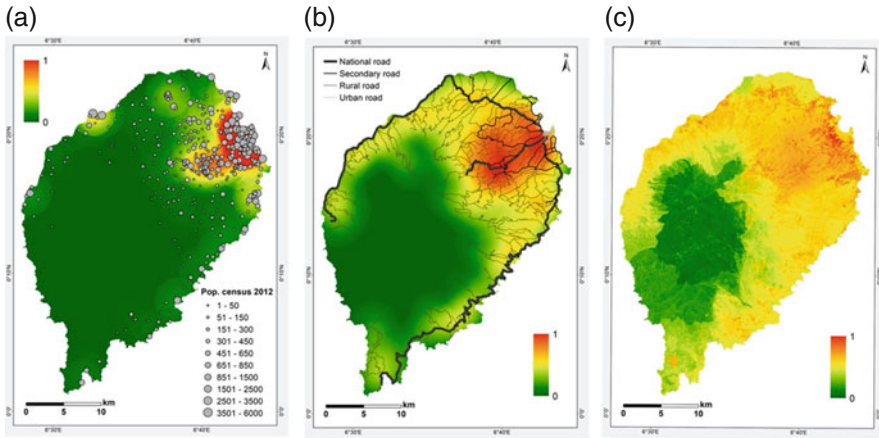


Fig. 4.5 (a) Population density derived from the 2012 census, (b) road density, and (c) landscape vulnerability based on a multifactorial analysis of São Tomé Island in Mikulane (2019). The coloration for all three graphs represents linear standardization

mobility, which will be greater. At the same time, this presupposes, following the traditional settlement and housing model, a clear tendency to occupy more territory: the city of São Tomé, which had an orthogonal plan of origin, will tend to grow sharply, irregularly, and haphazardly rather than a compact model in line with sustainable urbanism. However, the National Plan for Spatial Planning PNOT, currently under preparation (MIRNASTP 2020a), may be an important guide to improve territorial management, as long as they are able to support regulated and enforceable public policies in planning and controlling growth in urban and suburban areas, which take into account the demographic and occupation dynamics of the territory that we have just described.

Culture and the Concepts of *Obô* and *Omali*: When Conservation Collides with Development

Anthropogenic pressure on the environment should not only be measured in terms of demographic expansion and the occupation of space, but also in terms of income levels, traditional uses, and the population's perception of the ecological wealth of the islands (Boya-Busquet 2008a, b, Mikulane 2019). Furthermore, the same anthropic pressure must be contextualized in the awareness of the pernicious impact of uncontrolled growth in demographic terms, and in terms of an economy that does not respect the environment and instead follows the trends of a globalized capitalist system. This is increasingly the reality on these islands, where the extreme poverty of most families, an unstable economy, low wages, low saving capacity, etc., are all at play. These constraints mean that even in the most urban environments, traditional

cultures persist with basic livelihoods that are largely supported by agriculture and the extraction of resources from the natural environment. The *Obô* still provides wood for construction and to make canoes, furniture and other utensils, firewood and charcoal for cooking, fruits, condiments, medicinal herbs, and sources of animal protein. *Omali* (sea) provides fish and shellfish, vital protein sources on the islands, as well as sand for construction. The highly informal and poorly quantified domestic market largely depends on these predominantly extractive activities. For example, it was estimated that in 2014 alone, São Tomé and Príncipe bakeries consumed around 5000 tons of firewood, mostly obtained from illegal harvesting in national forests (MOPIRNASTP 2019).

As an illustrative example of a prevailing mentality among islanders, the following testimony of a resident from Porto-Real, Príncipe, states: “Here [in Príncipe] there are no jobs, but there is *moandim* (a local tree) in the woods to make charcoal. Coal is easy money. If you take it to the market, it is sold straight away. If you cut a bunch of bananas, where do you sell them? With a sack of charcoal, I haven’t even arrived in the city yet and I’m already doing business” (Temudo 2008). In other words, the forest is a sure source of income for families, frequently used by many of the island’s inhabitants. Consequently, *Obô* and the *Omali* are seen by most islanders as an inexhaustible source of easily accessible resources, unlike plantations that are largely operated by the state or large agricultural companies, or existing jobs in the city, often with uncertain profit or low pay. It is the combination of a deficient family economy with abundant natural resources that reinforces the inhabitants’ direct dependence on natural resource extraction. This relationship was once more respectful and balanced, forming part of the animist beliefs themselves. For example, it was customary for fishermen to ask Mother Nature’s permission in advance and the tree’s forgiveness, before cutting it to make a canoe (Torres 2005). Currently, strong social changes, largely due to increased contact with the outside world, but also due to population growth itself, put at risk not only nature but also cultural identity. This interdependence between society and nature creates a certain perception of citizenship, which plays a crucial role in the conservation of ecosystems (Boya-Busquet 2008a).

The dense forests, in addition to being a source of resources, are also an unknown, dark, hidden, changing space for many islanders. This is where witches and sorcerers live, where outlaws hide, where the fearsome *cobra-preta* dwells (endemic to São Tomé), and where there is danger of illness or death. It is also in the depths of the forest that the spirits of the deceased live and are invoked, where uncertainty and fear are generated. It is wild place that at the same time imposes and deserves respect and challenges men to dominate it, as it is the antithesis of the civilized, the known, the controlled, which all originated from the devastation of this dark place. This feeling is also experienced in other cultures, at other times and under different circumstances (e.g., Urteaga González 1987). For instance, in school surveys (Boya-Busquet 2008a), drawings express the prejudice about the unknown space of forests, streams, and seas, and in which there is a clear ladder of values—evolving from the forest to the *roça* and to the city, as an evolution from a wild place to a civilized one. In any case, the same representations demonstrate the perception of the existence within the

Obô jiji, of an indomitable, still virgin place, where it is possible to find spirits, from which new knowledge, certain remedies, occult magic or the power of healers can be found.

There is, therefore, a great contradiction that can be explained by the generational shift (or disinterest) in relation to ancient beliefs and by the relativization of the importance of animism for the conservation of Nature. In essence, the impenetrable *Obô* is a place to respect, so perhaps it is not strange to think that the majority of the modest population considers the *Obô* (and the *Omali* as well) as a kind of “open bar,” “an immense and inexhaustible cornucopia” (Valverde 2000), a place to civilize and explore. As such, it is difficult to think of valuing biodiversity if it is not recognized as a shared and finite heritage, which if it disappears as a result of economic development will take with it a large part of the unique identity of the peoples of the oceanic islands of the Gulf of Guinea.

The strongly impregnated idea that natural resources are infinite and for the enjoyment and benefit of the immediate needs of its inhabitants, associated with rapid demographic growth, the exchange of habits and social references, and the liberalization of access to land, have caused the destruction of natural resources to accelerate in recent decades, making it urgent to apply a strict policy of conservation and modification of territorial planning standards. A multifactorial analysis of the elements that are affecting the ecosystems of the island of São Tomé revealed that more than two-thirds of the island have a high degree of landscape vulnerability (Fig. 4.5—Mikulane 2019). This approach reveals the long-evident trend of degradation (Tenreiro 1961), even in areas protected by law.

The awareness of the unique value of the forests, rivers, beaches, and seas of these islands by its inhabitants is relatively new, and becoming more widespread since the beginning of the twenty-first century. This transition was largely externally inspired, stemming from international programs such as ECOFAC (Albuquerque and Carvalho 2015), but is currently reflected in several national strategic documents (e.g., MIRNASTP 2016, MIRNASTP 2020a, b), which identify the values to be protected in coastal and marine ecosystems, inland waters, forestry, and agrarian ecosystems, and from which the establishment of the *Obô* Natural Park was derived (DGA 2006a, b). Despite clearly pointing out threats and challenges, awareness programs on these values have not been satisfactorily established or implemented, starting with the low presence of this topic in school curricula (Carvalho et al. 2010).

Despite legal regulations and strategies created to promote responsible environmental management, poor enforcement results in widespread transgressions in illegal activities such as systematic cutting of trees in protected areas without authorization (Espírito et al. 2020), indiscriminate extraction of sand from beaches, poaching of protected species, or fishing with prohibited gear. Awareness of the value of biodiversity as a shared heritage remains poorly rooted, or is outweighed by necessity, and the debate about its importance continues to have little practical effect.

Agricultural and urban land use are also often at odds with environmental protections. In addition to the expansion and intensification of small-scale agriculture carried out mainly by small owners, there are strong pressures inflicted by large concessions (Oyono et al. 2014). This is true both on the part of agricultural

corporations, which work to recover and intensify plantations, and on the part of urban interests, sometimes linked to tourism, which have even intruded into protected areas. As already denounced long ago (Tenreiro 1961), the development of intensive agriculture, concerned with above all profit and export, has been at the expense of natural ecosystems. In addition to the direct impacts of agriculture, the impact of improving the network of roads and other infrastructures has also resulted in further land use intensification. All these elements of modernization will continue to require more land; for example, continued horizontal expansion of single-family homes at the current urban growth rate is unsustainable.

Deforestation means not only an abrupt landscape change in the context of the islands, but also a change in climate regimes, with implications for the islands' ecology (Henriques 1917). These changes can be especially notable in terms of rainfall and, therefore, water supply. In this context, it is evident that it is difficult to strike a balance between conservation and development. As such, in the medium and long term, the prospect of retaining functional ecosystems on the islands is sobering. With the continued decline of local biological diversity, and, in particular, of endemic species, the islands' ecosystems will likely become increasingly fragile.

On the island of Príncipe, low demographic pressure and lower accessibility, associated with a more pro-conservationist policy, provide some hope for the preservation of its biodiversity and landscape integrity. The island was declared a UNESCO Biosphere Reserve in 2012 (UNESCO 2013), which is paired with a tourism model that leverages the unique landscape and cultural heritage. These circumstances have also attracted the interest of scientists and conservationists, leading to the description of new endemic species and the implementation of several successful conservation programs (e.g., Fundação Príncipe 2021). This approach seems to have influenced a more positive perception of biodiversity and stronger enforcement of environmental regulations, halting the trend of environmental degradation. These changes end up benefiting an economic model that centers nature conservation, although perhaps the benefits for the local population are less clear: so far, this theory has not been associated with changes in population demography or urban planning. One important consequence, however, is growing social inequalities created by strong foreign investment that has led to an increase in prices on the island. In addition, the small size of Príncipe means the species on this island are much more vulnerable to anthropogenic pressure, as they have much smaller distributions.

As a consequence of all of this, the first draft of the PNOT (MIRNASTP 2020a) outlines a more solid basis for the delimitation of uses in the territory and the urban expansion model. These include strict safeguarding of natural habitats and ensuring the balance of biophysical systems, and the sustainability of hydrological cycles, both those that constitute a forest or fish reserve and their buffer zones and agricultural regime zones. This document highlights a chapter on establishing the planning model that adopts the culture of territorial management, and a second chapter on measures to protect the environmental and cultural system. Proposed measures include the promotion of institutional and population awareness to preserve and enhance the notable natural and cultural elements, and the establishment of a

national policy for the environment, nature conservation, and protection of biodiversity, very much in line with correcting the effects of uncontrolled growth described above. It is therefore an encouraging instrument, or at the very least a basic statement of good intentions.

The Limits of Environmental Change: A Dystopian Panorama?

Given the current moment of social and economic development, the outlook for biodiversity conservation in the islands of the Gulf of Guinea is not very optimistic. In particular, the exponential growth of the population and, consequently, the increasing pressure exerted on natural resources suggest the future scenario will be one of rapid environmental degradation, with the ultimate outcome being the general depletion of the territory, deforestation, disappearance of beaches, the gradual erosion of ecosystems, and disappearance of endemic species, but also threats to the persistence of the allochthonous richness already adapted to the territory.

Is it possible to put limits on this Malthusian drama in these jewels of the Atlantic? Is it really impossible to think of an economic development that is not based on the exhaustion of territory? Will the islands' unique biological diversity persist? There is still time to promote effective territorial planning, to which must be added demographic containment, and the implementation of a rigorous environmental policy, based on good management of uses, but also on awareness and, primarily, on basic education. There is great difficulty in reconciling the management of resources recommended by specialists with local practices, needs, and interests, and even private or corporate ones. In this sense, there is still a lot of work to be done, and it will be a great challenge to overthrow many of the vested interests. Keeping up with the current pace, the current landscape of the islands may become unrecognizable in a short time. To curb the prospects created by the current development path and avoid the most devastating environmental scenarios, it is necessary to increase social and economic equity, allowing access to sufficient income to help change the population model and demographic and social growth. The ultimate goal is a shift in mentality that positively influences the valorization of the islands' unique biodiversity as a common heritage, which is in fact the clearest pillar for a differentiated and long-term sustainable economic and social development model.

References

- Albuquerque C, Carvalho A (2015) Relatório da Avaliação da versão de 2009 dos Planos de Manejo e de Gestão dos Parques Naturais de STP. ECOFAC V, São Tomé, São Tomé, 50 p
- Boya-Busquet M (2008a) Rapport à la nature et stratégies intégrées de conservation et développement. Le cas de São Tomé et Príncipe. Tese de doutoramento. Universidade de Montréal, Montréal

- Boya-Busquet M (2008b) Integrar conservación y desarrollo? Uso y representaciones sociales de la naturaleza en el Parque Natural Obô de São Tomé y Príncipe. In: Beltrán O, Pascual J (eds) *Patrimonialización de la Naturaleza. El marco social de las políticas ambientales*. Ankulegi, San Sebastián, pp 97–113
- Carvalho M, Loloum B, Aguiar E et al (2010) *Ecologia, Ambiente e Educação Ambiental em São Tomé e Príncipe*. MARAPA/ CTA, São Tomé
- Costa BFB (1913) Rapport—Travaux sur la maladie du sommeil. L'assainissement, la statistique, les services hospitaliers et la brigade officielle à l'île du Prince. Lisbon
- Diniz AC, Matos GC (2002) Carta da Zonagem Agro-Ecológica e da Vegetação de S. Tomé e Príncipe. Garcia de Orta, *Série Botânica* 15(2):1–72
- Direção-Geral do Ambiente (DGA) (2006a) Lei do Parque Natural do Obô de São Tomé (Lei n.6/2006). Ministério dos Recursos Naturais e Ambiente, São Tomé
- Direção-Geral do Ambiente (DGA) (2006b) Lei do Parque Natural do Obô do Príncipe (Lei n.7/2006). Ministério dos Recursos Naturais e Ambiente, São Tomé
- Espírito ADA, António MMDR, Mata AD, Veríssimo D, Lima RF (2020) Toward sustainable logging in São Tomé, São Tomé and Príncipe—final report. Conservation Leadership Programme, São Tomé, 18 p
- Eyzaguirre PB (1986) Small farmers and estates in São Tomé and Príncipe, West Africa. Tese de Doutoramento. Universidade de Yale, New Haven
- Ferrão JEM (2005) A aventura das plantas e os descobrimentos portugueses. Instituto de Investigação Científica Tropical, Comissão Nacional para as Comemorações dos Descobrimientos Portugueses & Fundação Berardo, Lisboa
- Figueiredo E, Paiva J, Stévant T, Oliveira F, Smith GF (2011) Annotated catalogue of the flowering plants of São Tomé and Príncipe. *Bothalia* 41:41–82
- Fundação Príncipe (2021) Fundação Príncipe. Available via <https://fundacaoprincipe.org>. Accessed 19 Sept 2021
- Henriques JA (1917) A Ilha de S. Tomé sob o ponto de vista historico-natural e agricola. *Boletim da Sociedade Broteriana* 27:1–197
- Instituto Nacional de Estatística de São Tomé e Príncipe (INESTP) (2012a) Dinâmica natural da população em São Tomé e Príncipe. São Tomé
- Instituto Nacional de Estatística de São Tomé e Príncipe (INESTP) (2012b) Estrutura da população de São Tomé e Príncipe. São Tomé
- Instituto Nacional de Estatística de São Tomé e Príncipe (INESTP) (2012c) Projeções demográficas de São Tomé e Príncipe no Horizonte 2035, São Tomé
- Mikulane S (2019) Degradationsrisiken tropischer Waldökosysteme—Multifaktorielle Fernerkundungs- und GIS-basierte Modellierung der Landschaftsvulnerabilität. Umgesetzt am Fallbeispiel von São Tomé. Tese de doutoramento. Universidade Ruprecht-Karls, Heidelberg
- Ministério das Infraestruturas, Recursos Naturais e Ambiente de São Tomé e Príncipe (MIRNASTP) (2016). Estratégia nacional e plano de ação da biodiversidade 2015–2020 (NBSAP II). São Tomé
- Ministério das Infraestruturas, Recursos Naturais e Ambiente de São Tomé e Príncipe (MIRNASTP) (2020a) Plano nacional de ordenamento do território de São Tomé e Príncipe. Proposta do Plano, Programa de ação. São Tomé
- Ministério das Infraestruturas, Recursos Naturais e Ambiente de São Tomé e Príncipe (MIRNASTP) (2020b) Plano nacional de ordenamento do território de São Tomé e Príncipe. Relatório (Análise SWOT e potencialidades). São Tomé
- Ministério das Obras Públicas, Infraestruturas, Recursos Naturais e Ambiente de São Tomé e Príncipe (MOPIRNASTP) (2019) Terceira Comunicação Nacional Sobre as Mudanças Climáticas. São Tomé
- Muñoz-Torrent X (2013) Engenhos, roças e mato. Ecologia e câmbio climático na geografia de Francisco Tenreiro. In: Brito B, Fernandes A, Castro A et al (eds) *Alterações climáticas e as suas repercussões sócio-ambientais*. Nerea Investiga, Aveiro, pp 50–65

- Oliveira JEDC (1993) A economia de S. Tomé e Príncipe. Instituto para a Cooperação Económica & Instituto de Investigação Científica Tropical, Lisboa
- Oyono PR et al. (2014) Allocation and use of forest land: current trends, issues and perspectives. In: Wassinger CDE, Flynn J, Louppe D, Hiol FH, Mayaux P (eds) *The forests of the Congo Basin—state of the forests 2013*. Observatoire des Forêts d'Afrique centrale of the Commission des Forêts d'Afrique centrale and Congo Basin Forest Partnership, Weyrich, pp 215–240
- Seibert G (2004) Os angolares da Ilha de São Tomé: Náufragos, autóctones ou quilombolas? *Textos de História* 12:43–64
- Seibert G (2015) Colonialismo em São Tomé e Príncipe: hierarquização, classificação e segregação da vida social. *Anuário Antropológico* 2:99–120
- Temudo MP (2008) De serviçal a camponês. A persistência das desigualdades sociais em São Tomé e Príncipe. *Lusotopie* 15:71–93
- Tenreiro F (1961) A ilha de São Tomé. Junta de Investigações de Ultramar, Lisboa
- Thompson WS (1929) Population. *American Journal of Sociology* 34:959–975
- Torres Â (2005) *Mionga ki ôbo: Mar e selva*. LX Filmes, Lisboa
- United Nations Educational, Scientific and Cultural Organization (UNESCO) (2013) *Ecological sciences for sustainable development. Biosphere reserves: the island of Príncipe* Available via <http://www.unesco.org/new/en/natural-sciences/environment/ecological-sciences/biosphere-reserves/afrika/sao-tome-and-principe/the-island-of-principe>. Accessed 19 Apr 2021
- Urteaga González L (1987) *La tierra esquilhada. Las ideas sobre la conservación de la naturaleza en la cultura española del siglo XVIII*. Ediciones El Serbal, Consejo Superior de Investigaciones Científicas, Barcelona
- Valverde P (2000) *Máscara, mato e morte em São Tomé*. Celta, Lisboa

Open Access This chapter is licensed under the terms of the Creative Commons Attribution 4.0 International License (<http://creativecommons.org/licenses/by/4.0/>), which permits use, sharing, adaptation, distribution and reproduction in any medium or format, as long as you give appropriate credit to the original author(s) and the source, provide a link to the Creative Commons license and indicate if changes were made.

The images or other third party material in this chapter are included in the chapter's Creative Commons license, unless indicated otherwise in a credit line to the material. If material is not included in the chapter's Creative Commons license and your intended use is not permitted by statutory regulation or exceeds the permitted use, you will need to obtain permission directly from the copyright holder.

