THE EVOLUTION OF FLORA IN THE ISLAND OF S. TOMÉ – THE SOCIAL, ECONOMIC AND ENVIRONMENTAL IMPACTS OF COLONISATION

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ABSTRACT
The Island of S. Tomé, located in the Gulf of Guinea, is part of one of the smallest countries on Earth, registering only 163,784 residents. It is also a very biodiverse equatorial environment, discovered by the Portuguese, in 1470. Exuberant native vegetation covers most of the island, even though it has suffered logging in order to give way to sugar plantations between 1494 and 1610, as well as coffee and cocoa plantations from 1780 onwards. Current submission stems from research conducted in the now independent country, in 2019, by the University of Lisbon. The objective was to find out if the depredation suffered in colonial times had any significant impacts on the environment, on food security and on the wellbeing of the Gulf of Guinea islanders. Methodology was three-fold: (1) examination of old manuscripts and recent literature about the history of plantations, so as to enumerate the plant species existent in the beginning of colonisation and the ones introduced during colonisation; (2) survey to fifty urban residents, in modern times, so as to evaluate the economic and environmental impacts of Portuguese presence and economic management; (3) identification of flora. The in-depth interviews aimed four focus groups: (i) fruit, roots, staples, spices, and medicinal plant traders, found in markets and along the streets (74%); (ii) urban and peri-urban farmers that cultivated food plants, spices and medicinal flora (20%); (iii) traditional healers also involved in flora cultivation (4%); (iv) one touristic guide that traded medicines grown and processed in a Botanical Garden, located further inland (2%). The survey accounted for 111 botanical species, some of which were native. The hope is to contribute for a better understanding of the evolution of flora consumption in Africa, and to explain why there was no serious depredation in this Gulf of Guinea Equatorial environment.
Keywords: Environment; Equatorial; S. Tomé; Nutrition; Medicines; Flora; Africa

1 INTRODUCTION

The island of S. Tomé, from now onwards referred to as ST, was discovered by the Portuguese navigators Santarem and Escobar in 1470, during the kingdom of Afonso the fifth, so-called "The African". His son, John the second, initiated the colonisation of the exuberant equatorial environment, while attributing this domain to Captain Álvaro Caminha, and sending him there together with several Jewish children, all under 14 years of age, taken away from their parents in Europe. In fact, Jews expelled from Castile and Aragón were soon permitted to settle in Portugal, exiled from the domains of the Catholic queen and king [1]. A colony had been prospering for a long time in the small country, influential and educated people that the Portuguese kings appreciated. However, under demand of Rome and the Inquisition, the kingdom that protected them was unable to give Jews full support as it was required that the newly established families should convert themselves to the Christian faith. S. Tomé was the solution found by King John, a far-away place where Jewish youngsters could escape to the ancestral influence of their parent's faith, simultaneously colonising a promising land with no known residents [2].

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Chronicle writers such as Damiam de Goes and Garcia de Resende [3], never clearly mention the pre-existence of local indigenous residents in ST. But, by the end of the 15th century there was already a fair economic trade between Portugal, the African island and Flemish cities such as Antwerp and Bruges, because the maritime sagas were expensive enterprises for the Portuguese kingdom. King John the second (1481–1495) was closely related to Maximilian the first (1459–1519), who was his cousin, which facilitated the exportation of sugar from sugarcane plantations established both in the island of Madeira and S. Tomé, as well as the African Pepper (*Amomum melegueta*), a substitute for the expensive and rare Indian Pepper (*Piper nigrum*), brought from the Golden Coast and ST [4]. It is known that sugar from ST soon excelled the production of Madeira, a northern island discovered in 1420 [5]. In commercial terms, the first economic cycle of sugar dominated from around 1494 to 1610, in ST. In the eighteenth century *Coffea arabica* was introduced in the island but was soon attacked by pests and diseases, making the cycle of coffee the shortest agrarian domination of one single crop, from 1780 to 1822. After the independence of Brazil, in 1822, ST replaced coffee by cocoa, thus becoming the main Portuguese colony to grow *Theobroma cacao*. With this American species, other fruit and staples were introduced in the island, altogether enriching local diet and adding exuberance to local forests and gardens.

This contribution is part of a project aimed at answering the question: Was flora consumption sustainable in ST, from the beginning of Portuguese colonisation to our days? In order to find responses the methodological approach was threefold, starting with the examination of three Renaissance manuscripts, followed by a scientific mission to the island, aimed at conducting a survey to useful flora consumption in our days, intended to evaluate the sustainability of native plant species through times. The structure of the paper, after this introduction, plus the geographical location and methodology, will include the discussion of the results gathered in the city of S. Tomé, the capital of ST, illustrated with tables and photos, as well as the evolution of the crops and vegetation mentioned in literature, towards a conclusion.

2 GEOGRAPHICAL LOCATION

Located in the Gulf of Guinea, at 1°42′ north and 0°1′ south of the Equator, ST Island was an important Portuguese agrarian post in Africa from the beginning of colonisation [6]. It has an equatorial environment that registers 1,285mm of rainfall per annum and average 25° of temperature [7]. The World Bank estimates that about a third of the population lives with less than 1.9 dollars per day, and that over 2/3 of the population are poor, under the poverty line of 3.2 dollars per day [8]. Independent from Portugal, from 1975 onwards, the country is rich in volcanic soils, and in oil; however, the oil reserves remain unexplored, postponed by international corporations because of the low price of the barrel. These days, the country survives on tourism and agriculture, mainly on cocoa production, and it is considered an oasis for tropical plant species of any kind (see map in Fig. 1).

3 OBJECTIVES AND METHODOLOGY

The food, spices and medicines growth and trade project focusing African countries, currently developed in the University of Lisbon, has two main aims: (1) To contribute for a better understanding of the evolution of flora consumption; (2) To present a trend of good practises to be explored, in order to increase the wellbeing of ST urban residents. In fact, all useful flora is under scrutiny because, as was the case with previous similar studies developed in Latin America [9] and in Asia [10], as a researcher of the Tropical Institute (IICT), plant

Figure 1: S. Tomé island (ST) and Príncipe (Prince) located in the Gulf of Guinea *(Source: https://www.ezilon.com/maps/images/africa/Sao-Tome-physical-map.gif).*

species used as natural remedies are very numerous in the gardens, peri-urban farms, and in local markets. The main objective of this contribution is to find out if the depredation suffered in colonial times had any significant impacts on the environment, on food security and on the wellbeing of the ST islanders.

The paper proposed for this conference starts with the examination of three 16th century manuscripts, by Damiam de Goes and Garcia de Resende, where the first African plant species are mentioned. Other manuals, such as the writings of British historian Elaine Sanceau [5] were examined. There were three phases in the methodological process: 1) Examination of 16th century manuscripts, by Goes [1, 2] and Resende [3], two chronicle writers sponsored by Portuguese king John the 3rd; 2) Investigation of the current uses of flora in S. Tomé, ST, conducted during a scientific mission, in the year 2019, aimed at gathering in-depth interviews to four categories of informants: i) fruit, roots, staples, spices, and medicinal plant traders, found in markets and along the streets (74%); ii) urban and peri-urban farmers that cultivated food plants, spices and medicinal flora (20%); iii) traditional healers also involved in flora cultivation (4%); iv) one touristic guide that traded medicines grown and processed in a Botanical Garden, located further inland (2%).

The survey totalled 50 respondents. 3) The botanical identification of all flora mentioned in the manuscripts, and collected during fieldwork, was the following and last procedure, so as to permit the cross-examination of data, both through times and across the world, using the Missouri Botanical Garden and the Royal Kew Gardens norms, easily available online [11, 12], complemented with the University of Trás-os-Montes e Alto Douro (UTAD) online list of European plant species and citrus trees [13]. The results gathered during this second mission to Africa have already been presented to a Portuguese Geographers Congress, in the University of Minho, Guimarães, in November 2019.

4 RESULTS AND DISCUSSION

According to the Portuguese IICT botanist Cândida Liberato [6], the first expeditions to ST were conducted by foreigners, namely the French Palisot de Beauvois, in 1787; the British George Don, in 1822; the famous Austrian botanist Welwitsch, under sponsorship of the Portuguese government, in 1853; Gustav Mann, another British naturalist, explored the island from 1859 to 1863; the medical doctor Rattay, in 1886; and the French botanist Auguste Chevalier, in 1905. African plant species have been studied by Portuguese botanists either, such as Jacinto Augusto de Souza, in 1880; the Earl of Ficalho, in 1884; and the Coimbra University Professor Júlio Henriques, in 1903. The specimens collected during all those expeditions are deposited in the Universities of Coimbra, Paris, Lyon, Leiden, and Genève, Berlin and in the Kew gardens, in London [6, 14, 15].

Being so biodiverse, the equatorial island was continuously studied by natural history scientists during the 20th century. In 1936 the Portuguese government created a Research unit exclusively dedicated to the botanical and agrarian exploration of the Overseas colonies, a mission fulfilled by the Portuguese Tropical Research Institute (IICT), founded by the King Luis (1861–1889) in the nineteenth century, institution that added scientific data even after the independence of ST, in 1975, and only terminated in 2015, when IICT was extinct [6, 16, 17]. With the integration of all researchers and the archives in the University of Lisbon, the IICT project on the issue of useful plant species from tropical environments continued, with current contribution (see photos in Fig. 2).

Figure 2: Safuzeiro and safú (*Dacryodes edulis*) the tree and the fruit *(Source: Author's photos, 2019).*

4.1 The Evolution of flora in the African island

During the years 1885 and 1886, the naturalist Adolpho Moller was sent to ST by the University of Coimbra. He recorded the existence of oca (*Ceiba pentandra*), an American species introduced by the Portuguese from Brazil, and the palm oil dendem (*Elaeis guineensis),* an African tree already mentioned in 16th century manuscripts [1–3]. The University Professor Júlio Henriques emphasized that a good number of other exotic species were present in ST, such as *coffea arabica*, *Theobroma cacao, Artocarpus altilis* (breadfruit), *Cinchona officinalis* (quina), an anti-malarial tree introduced in 1868, vanilla and coconuts, the last one predominant along the coastal areas. African species were also mentioned and recorded by him, in his 1903 scientific mission to ST, namely the palm tree *Borassus aethiopum*, *Adausonia digitata* (baobab), the local *Pandanus thomensis* (see Fig. 3), *Olea welwitschii* and *Treculia Africana*, vernacular iza-quente or African breadfruit [14]. Henriques was much worried with the deforestation caused by cocoa plantations, and predicted that excessive exploitation could cause biodiversity loss and scarce rainfall.

During the period 1956–1973, another naturalist and collector, Espírito Santo, listed several endemic taxa, at the service of IICT, and evaluated their conservation status. The material examined was deposited in the Herbarium of the Centre of Botany, now integrated in the University of Lisbon [16]. Tall endemic trees such as: *Croton stellulifer* (25–30 metres high); *Discoclaoxylon occidentale* (18–20 metres); *Homalium henriquesii* (15 m); *Psychotria hierniana* (8 m) and *Drypetes henriquesii* (18–25 metres high) were recorded in ST. On the contrary, other endemic trees like *Drypetes glabra* (15–20 m); *Standtia pterocarpa* (18–35 m) and *Craterispermum montanum* (15 m) were already very rare, and are now in the Plant Red List.

The researcher José Cochicho Ramalho, from the IICT, considers *Coffea arabica* as an African species, in spite of being worldly known as an Arabian drink. The plant was introduced in ST from Brazil, where it started being grown in 1727. Coffee plants can be found in Ethiopia up to 2,000 metres of altitude, but in ST it only grows up to 1000 m. Equatorial climate is quite adequate for this species as it requires above 1,000 millimetres of rainfall; coffee produces better between 17 and 22.5°C [17]. Had it not been attacked by the coffee leaf rust, caused by a fungus, the cycle of coffee could have continued from 1780 to our days. However, there are still coffee plantations; the most productive one is Monte Café Farm (Roça, in Portuguese, in Fig. 4).

Figure 3: (*Pandanus thomensis),* vernacular Pau-esteira *(Source: Author's photo, 2019).*

Figure 4: Monte Café Farm, in S. Tomé *(Source: Author's photo, 2019).*

Unlike sugarcane, planted along the seashores, cocoa was farmed further inland, such as coffee, where it grew mixed with native vegetation, because cocoa plants need shade, and therefore tall native trees provided necessary conditions for a good production. Depredation of forests was not as serious in this agrarian cycle, as in the previous two, though, in spite of the concerns of Júlio Henriques, in the beginning of the 20th century. After independence very few species of *Theobroma cacao* were planted, against the advice of World Bank experts. They wanted hybrid plants to be grown instead of the old ones, but local residents refused.

4.2 Food and spices grown and traded now and in the 16th century

Flora mentioned in both manuscripts examined totalled fifty-three [1–3]. Only a couple is of interest to ST, namely the African Chilli (*Amomum melegueta*) and the African oil palm (*Elaeis guineensis*). Table 1 presents 15 food plants and spices traded in ST, in the 16th century and in our days. As it happened in Accra, Ghana, bananas are top-ranking food species. The Musaceae was disseminated all over the world by the Portuguese, and it is considered an Asian species [15]. Breadfruit follows suit, introduced in ST by the Baron of Agua-Izé, between 1856 and 1858, probably in order to feed his slaves, who grew coffee and cropped cocoa seeds in his farm or roça Agua-Izé [18]. By contrast, local African breadfruit (*Treculia africana*), only had a couple of occurrences in the 2019 University of Lisbon (UL) survey; the seeds can be consumed like beans or peanuts, in salty or sweet dishes [18].

The most consumed spice is the American chilli pepper (with 11 occurrences), preferred to native *Amomum melegueta* (3 collections). Other local spices were recorded, such as *Piper guineensis* (2 occurrences), *Ocimum canum* (5 occurrences) and *O. gratissimim* (4). As to fruits, following bananas and breadfruit, the most popular is safú (see Fig. 2), an African pear (11 collections). The tree grows up to 25 metres, and the fruit is usually collected from the forests, and consumed raw in ST, sometimes together with bread. However, the sweetest is an American introduction, quite common in urban gardens, sape-sape (see Fig. 5). It registered 7 occurrences, during the UL mission, and has a strange aspect, but the white pulp is delicious.

The main dish cooked in ST is calulu, eaten with chicken or fish; the ingredients are grown locally and traded in local markets: pumpkin leaves (7 occurrences); chilli peppers (11 occurrences); maquequê (with 6); ponto leaf or devil's horsewhip (5 collections); African basil or micocó (4); selô-sum-zom-maiá (*Eryngium foetidum*, with 3 occurrences); Hoary basil (*Ocimum canum*, with 5); endemic *Begonia baccata* leaf and banana. The most appreciated local staple is coco-yam, known as matabala in ST, with 5 collections. It is illustrated in Figure 6. Of course, the most precious production is cocoa, planted in rural areas and exported overseas. A total of 111 botanical species were accounted for, during the 2019 scientific mission to ST, 41.4% of which were consumed as food and 6.3% as spice.

4.3 The Natural remedies used in ST

About a half of the 111 plant species recorded during the scientific mission to ST (fifty-six) were medicinal plants. Table 2 lists 10 vernaculars of flora, their botanical identification, the number of collections and the uses mentioned by traditional healers, growers and traders interviewed. All enumerated species are native. Anti-malarial activity of bitter tea vernonia and sweet morinda has been proved in the Pharmacognosy laboratory of the University of Coimbra. Several plants have dual uses, such as maquequê; this Solanaceae is both cooked in calulu and taken in infusions because of its anti-anaemic effects. It is a nutraceutical.

Table 1: Food and spices traded and grown in ST, in the 16th century and today *(Source: Author, 2019).*

Common names	Botanical names	Occurrences (*n.*)	Manuscripts mentioned
African Chilli	*Amomum melegueta* Roscoe ZINGIBERACEAE	3	[1] [2] [3]
Avocado	*Persea americana* Mill. LAURACEAE	7	–
Banana	*Musa paradisiaca* L. MUSACEAE	16	–
Breadfruit	*Artocarpus altilis* (Parkinson) Fosberg MORACEAE	13	–
Coconut	*Cocos nucifera* L. ARECACEAE	10	–
Lemon	*Citrus limon* (L.) Burm. f. RUTACEAE	10	–
Mango	*Mangifera indica* L. ANACARDIACEAE	8	–
Maquequê	*Solanum macrocarpum* (Maxim.) Kudô SOLANACEAE	6	–
Palm seeds, African palm	*Elaeis guineensis* Jacq. ARECACEAE	5	[1] [2] [3]
Pear squash	*Sechium edule (*Jacq.) Sw CUCURBITACEAE	8	–
Peppers, Chilli pepper	*Capsicum annuum* L. SOLANACEAE	11	–
Pumpkin	*Cucurbita pepo* L. CUCURBITACEAE	7	–
Safuzeiro, Safú	*Dacryodes edulis* (G. Don) H.J. Lam BURSERACEAE	11	–
Soursop *Sape-Sape*	*Annona muricata* L. ANNONACEAE	7	–
Tomato	*Solanum lycopersicum* L. SOLANACEAE	12	–

Figure 5: Sape-Sape or soursop, from an ST garden *(Source: Author's photo, 2019).*

Figure 6: *Matabala*, the African staple consumed in ST *(Source: Author's photo, 2019).*

A curiosity found in ST was that plant species with white flowers, or considered female herbs, as was the case with *malé* (white weed), and *mussa*, are used in baths for vaginal problems or applied in massages to ease child delivery, whereas the red flowered *mussa* is consumed in teas against kidney stones, and *malé* males consumed against prostate problems. This association of flower colours to the sex of the patient has only been encountered amid the Incas, as the Inca Garcilaso de la Vega has written in his 17th century manuscript, and it was recorded to be still in practise, in contemporaneity, in Peru [19, 20].

Table 2: Medicinal plant species traded and grown in ST (Source: Author, 2019).

Common names or vernaculars	Botanical names	Occurrences (n.)	Uses mentioned
Bitter tea Vernonia *Libu*	*Vernonia amygdalina* Delile ASTERACEAE	3	Anti-malarial, diabetes, analgesic, hypertension
Cana de macaco	*Costus giganteus* Welw. ex Ridl. COSTACEAE	3	Bone settler, Children aches
Macambrara	*Craterispermum montanum* K.Schum. RUBIACEAE	1	Hypertension
Majolô, Manjolô	*Solenostemon monostachyus* (P.Beauv.) Briq LAMIACEAE	2	Influenza, cold.
Maquequê	*Solanum macrocarpum* (Maxim.) Kudô SOLANACEAE	6	Anti-anaemic
Mussas branca e vermelha	*Thunbergianthus quintasii* Engl. SCROPHULARIACEAE	2	Red-kidney stones. White–child delivery
Quinine tree *Cata-grande*	*Rauvolfia caffra* Sond. APOCYNACEAE	2	Diabetes, anti-malarial
Pau-três	*Allophylus grandifolius* (Bak.) Radlk. SAPINDACEAE	2	Diarrhoea, massages, aphrodisiac
Sweet Morinda *Grigô, Gligô*	*Morinda lucida* Benth. RUBIACEAE	3	Anti-malarial Skin healer
White weed *Folha Malé, macho e fêmea*	*Ageratum conyzoides* L. ASTERACEAE	2	Male-prostate problems. Fem.-vaginal problems

5 CONCLUSIONS

So, was flora consumption sustainable in ST, from the beginning of Portuguese colonisation to our days? The answer to the research question is yes. Colonisation was accomplished using Jews, French, Genovese, and all types of marginalised individuals, together with slaves from mainland Africa. Sugarcane plantations required heavy workforce and so King John the 3rd (1521–1557) nominated a governor to represent the Portuguese Crown in ST. With the union of the Portuguese and the Spanish kingdoms, between 1580 and 1640, the cycle of sugar faded away, and a cycle of stagnation followed suit, based on triangular trade between Europe, Africa and the Americas. Coffee and cocoa, were economic cycles established only after the 18th century, in big plantations (roças), using slave labour to the abolition of slavery in 1875.

Workers from then onwards were imported from other Portuguese colonies, like Angola, Cabo Verde, Guinea, Mozambique, as well as from other west African locations, like current Gabon and Sierra Leone [21]. All services, from schools to hospitals were established in the plantations, railways and roads were built in order to permit the shipment of cocoa and coffee abroad. Following independence from Portugal, all farms were expropriated and the new government took over management and cocoa production. Because farms were kept as they were, during Portuguese colonisation, biodiversity increased and secondary forests took over most of the island. ST is a paradise in waiting.

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