

International Urban Planning Workshop

Adapting island territories to climate change



Réunion Island

Actions for island resilience

Context document

Context document of the International Urban Planning Workshop

25 September 2021 - 08 October 2021

Réunion Island, France

les ateliers
maîtrise d'œuvre urbaine



Les Ateliers Internationaux de Maîtrise d'Œuvre Urbaine de Cergy-Pontoise

Immeuble le Verger, rue de la Gare
95000 Cergy
Tél : +33 1 34 41 93 91
contact@ateliers.org

Les Ateliers de Cergy is a non-profit association created in 1982 at the behest of the urban planners involved in the creation of the New Town of Cergy-Pontoise. Today, it is an international network of professionals, academics and decision-makers tied to the field of urban planning. Focused on the practice of urban development, the association organizes workshops envisaged as spaces for collective design and creativity. In France and elsewhere, these workshops provide project managers with an international perspective and illustrated proposals highlighting territorial strategies and urban development projects. By bringing together different professions and cultures, they also offer the opportunity to exchange at the highest level.

Les Ateliers team

Pilots:

Jean GREBERT - Engineer and architect, mobility expert
Christophe BAYLE - Architect and urban planner
Ning LIU - Architect and urban planner

Assistants-pilots:

Jeanne-Marie FONTAINE - Architecte
Julie SMEYERS - NGO's project management

Coordination:

Simon BROCHARD - Geographer

Projects director:

Véronique VALENZUELA - Geographer

Director :

Christine Lepoittevin - Sociologist

The "Island Territories" workshop is an initiative of the French Development Agency (AFD) and its "Three Oceans" department, who have chosen to work together with Les Ateliers to examine the specific problems concerning the development of island territories in the face of climate change. In order to explore these dimensions, Les Ateliers, with the support of AFD, organized a series of trans-oceanic meetings in 2020.

This work will take its roots in the regional dynamics of the Indian Ocean. Firstly, through an international urban planning workshop to be held on Réunion Island which will bring together fifteen professionals from across the world, all volunteers, from 25 September to 8 October 2021. Réunion as a territory serves an ideal working terrain for these reflections and for the production of proposals of various scales.




This work was made possible by the continued support of the local communities that were partners in the workshop: Réunion Region, Réunion Department, intercommunalities of CIVIS, TCO and CIREST, and the municipalities of Saint-Louis, Saint-Leu and Saint-Benoît. It was also made possible by the support of the Banque des Territoires and the Ecole Nationale Supérieure d'Architecture de Montpellier / La Réunion.

This document aims to present the territory of Reunion Island and the major issues of the island linked to climate change and insularity, and to give some keys to understanding the context of the Indian Ocean's islands. It was written by Jeanne-Marie Fontaine and Simon Brochard. It was translated into English by Susanna Hsing.

Secondly, a post-workshop collaborative project on the scale of the Indian Ocean and other territories will seek to draw lessons and perspectives for the region's island territories based on the reflections produced by the Réunion Island Workshop.



Table of contents

I. The richness and diversity of Réunion Island	4	
A. Réunion's powerful geography		
B. An island at the crossroads of numerous cultures		
C. A heterogeneous occupation of space		
II. The challenge of insularity in the face of climate change	30	
A. Facing the threats to ecosystems		
B. Respecting the limits of a finite territory		
C. Reducing economic and island vulnerability		
III. Territories of interest	56	
A. From the Etang du Gol to Les Makes		
B. The watershed of Saint-Leu's bay		
C. Along the water in Saint-Benoît		
Bibliography & Endnotes	88	

I. The richness and diversity of Réunion Island

A. Réunion's powerful geography

1. The birth of a volcanic island

In the Indian Ocean...

The Indian Ocean, a vast expanse of water representing 21% of the earth's surface, is the maritime space bordered by the African continent to the west, India to the north, Australia and Indonesia to the east, and the Southern Ocean to the south. The Indian Ocean is the warmest of the oceans: it consists mostly of tropical waters. The high ocean temperatures allow this area to host a significant proportion of the world's coral reefs. These characteristics are the foundation of the paradisiacal imagery of many of the region's coastlines: beaches with warm, azure blue waters are relatively common.

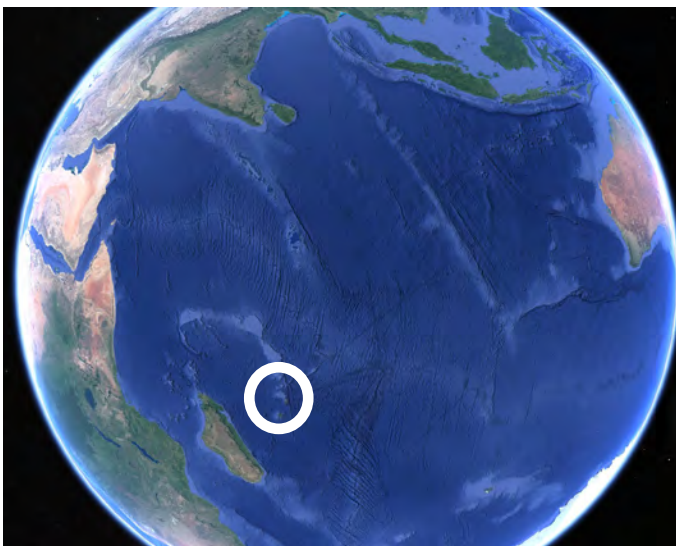
Apart from the surrounding continents, the Indian Ocean has many land masses in the form of islands – Indonesia alone has over 13,000. They range in size from the small islets of the Seychelles to Madagascar, the fourth largest island in the world.

Within this landscape, roughly 700 km off the east coast of Madagascar, is a group of islands called the Mascarene Archipelago. This archipelago consists of three main islands: Réunion, Mauritius (220 km east of Réunion), and Rodrigues (600 km from Mauritius in the same direction). Although they are quite distant from each other, these islands are linked by their geological history.

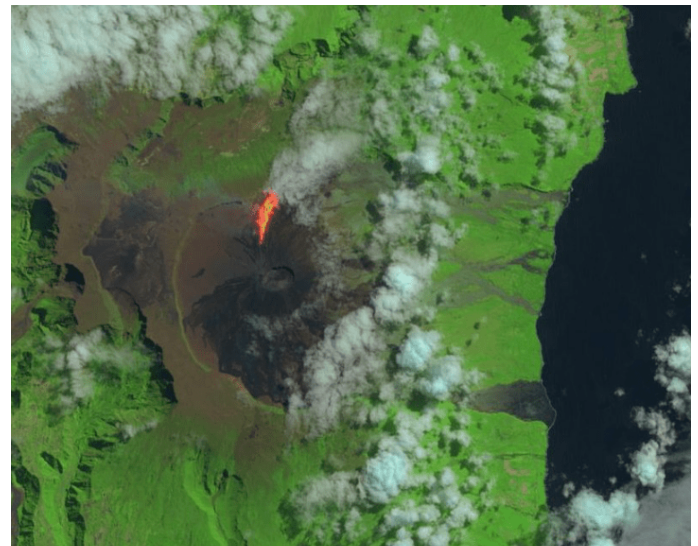
... emergence from volcanic activity

This archipelago is in fact the result of volcanic activity that separated the continents and created island spaces over millions of years. The Réunion "hotspot" is one of the main centres of volcanic activity on the planet as it home to hot upwellings of the earth's mantle called plumes. Although this hotspot has been active for 65 million years, it was only during eruptions 10 million years ago that an alignment of islands began to form. The molten rocks rose from the ocean and gradually created gigantic basalt cones emerging from the water. The first of these was Rodrigues, followed by Mauritius, which is thought to have emerged around 7 million years ago. Réunion is much younger, since the volcano at its origin would have reached the open air only 3 million years ago. These important temporal differences explain the distances separating these three islands (displacement of the oceanic plate) as well as their varied topographic profiles (erosion over time): while the highest peak of Rodrigues reaches 398 metres, Mauritius has its highest point at 828 metres and Reunion at 3,071 metres.

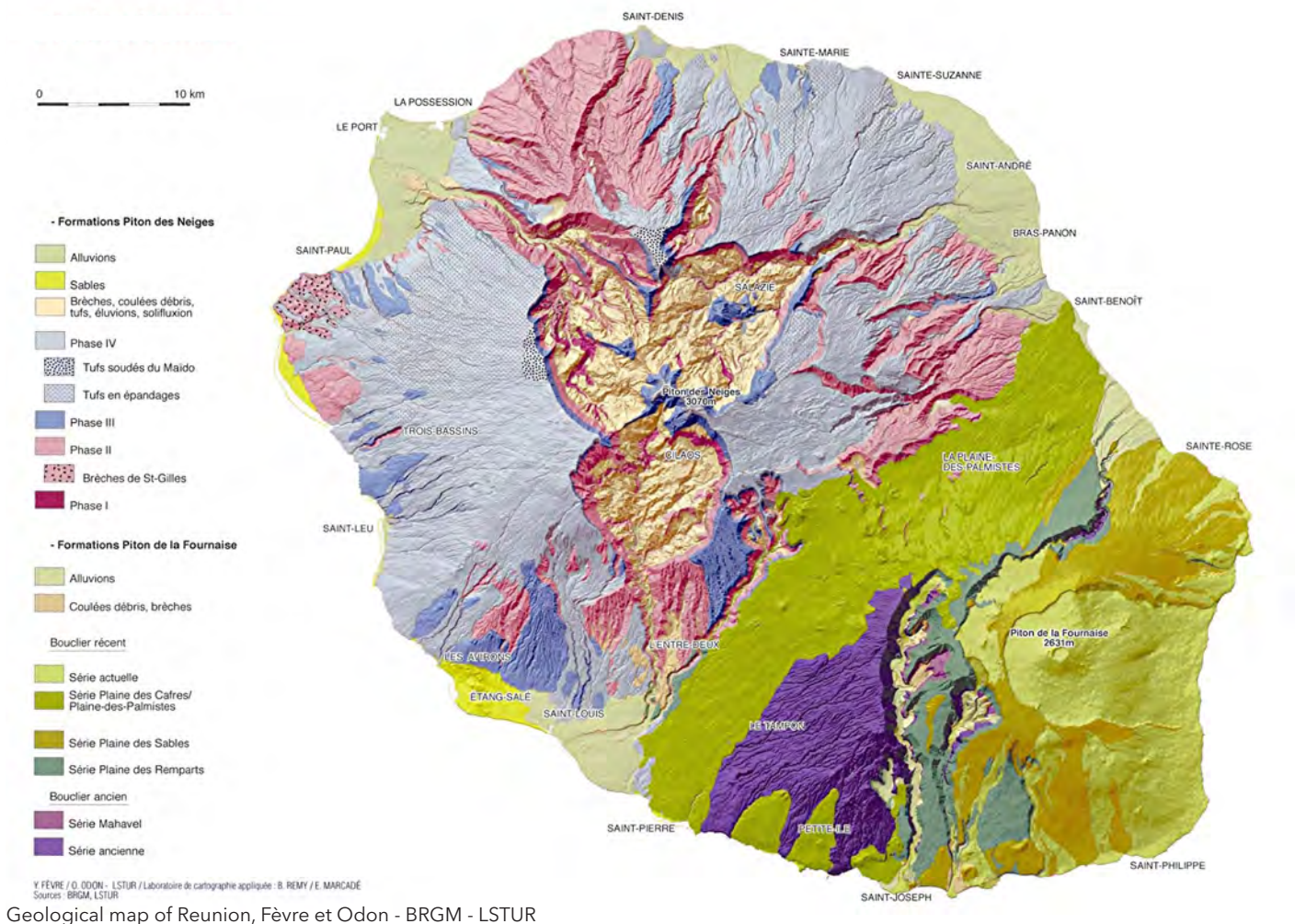
Réunion Island is thus the result of the activity of two volcanoes that erupted successively, then to some extent simultaneously. The first of these volcanoes reached 4,000 metres above ocean level and finally died out around 22,000 years ago: today it is the Piton des Neiges massif, a volcanic edifice that occupies three-fifths of the island and whose summit is the highest in the Mascarene Islands. The second volcano, Piton de la Fournaise, is said



Localisation of La Réunion in Indian Ocean Indien, Google Earth



Eruption's skyview of Piton de La Fournaise, LANDSAT



Geological map of Reunion, Fèvre et Odon - BRGM - LSTUR

to have emerged a million years ago and is still active. It is one of the most active volcanoes in the world, particularly in terms of its frequency of new eruptions (one every nine months for the past ten years on average). It occupies the remaining 40% of the island and currently reaches an altitude of 2,632 metres.

The end of the eruptions of the Piton des Neiges has allowed other phenomena to continue sculpting the Réunionese landscape. Erosion, facilitated by the significant differences in level and the sometimes aggressive climate, is mainly responsible for the carving of three natural amphitheatres with steep walls that surround the summit of the piton: Mafate, Cilaos and Salazie. These three oval-shaped cirques have a diameter of approximately 10 km and each has a single hydraulic outlet, fed by a fairly well organized hydrographic network made up of "ravines", the deep beds dug by the torrents in the steep relief of the island. The high rocky walls that delimit the cirques are called "remparts" and are also present elsewhere on the island. Réunion is therefore a young island whose volcanic origin has formed spectacular landscapes that determine the array of climates and life of the territory.¹



Ramparts and circus of Cilaos, Jean-Marc Lisse

I. The richness and diversity of Réunion Island

A. Réunion's powerful geography

2. Landscapes, climate and biodiversity

The diversity of climates

Réunion is an island territory with a surface area of 2,512 km²: it is 72 km long and 51 km wide, with a circumference of 210 km. Located in the southern hemisphere, slightly north of the Tropic of Capricorn, the island enjoys a tropical climate tempered by trade winds and characterized by two main periods: one dry and temperate (the southern winter, from May to October) and the other hot and humid (the southern summer, from November to April).

On the coast, daytime temperatures are mild in winter (22-24°C) and hotter in summer (30°C). The rainy, cyclone season is concentrated at the end of the summer, between January and March. The high temperatures at the surface of the ocean lead to greater evaporation and feed the water cycle, therefore producing rainfall. This takes the form of relatively short but very intense rainfall episodes. Réunion holds every world record for rainfall measured during a single period for periods ranging from 12 hours to 15 days.

The island's climate is notable for its great variability within the territory, which is linked to its geography. Annual rainfall rates reveal a significant disparity between the east and west of Réunion. In the west, rainfall is rather rare. On the other hand, the further east one looks, the more rainfall accumulations increase, reaching values exceeding 10 metres per year, an exceptional level on a global scale. The high relief of the island is the cause of this east-west duality. Precipitation tends to be concentrated in the regions directly exposed to the oceanic humidity brought on by the trade winds, moving from east to west: they are considered the "Côte-au-Vent". The winds cannot reach beyond the high reliefs and therefore clouds form over the eastern part of the island. The western part is called the "Côte-sous-le-Vent" (Windward Coast), as it is not directly exposed to the trade winds.

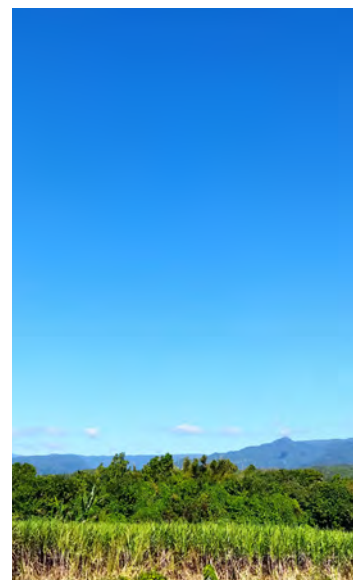
This climatic difference contributes significantly to the diversity of the island's coastal landscapes: it explains in particular the presence of coral reefs and the lagoon in the west. Indeed, specific climatic conditions, such as warm water sheltered from tumultuous agitation, are necessary for coral to develop not far from the calm and sunny beaches. To the east, the waves reach the coast directly and offer a wilder spectacle of waves and foam against the rocks.

In addition to this east-west climatic dissymmetry, there are significant differences in temperature depending on altitude. Along the island's slopes, the "thermal gradient"

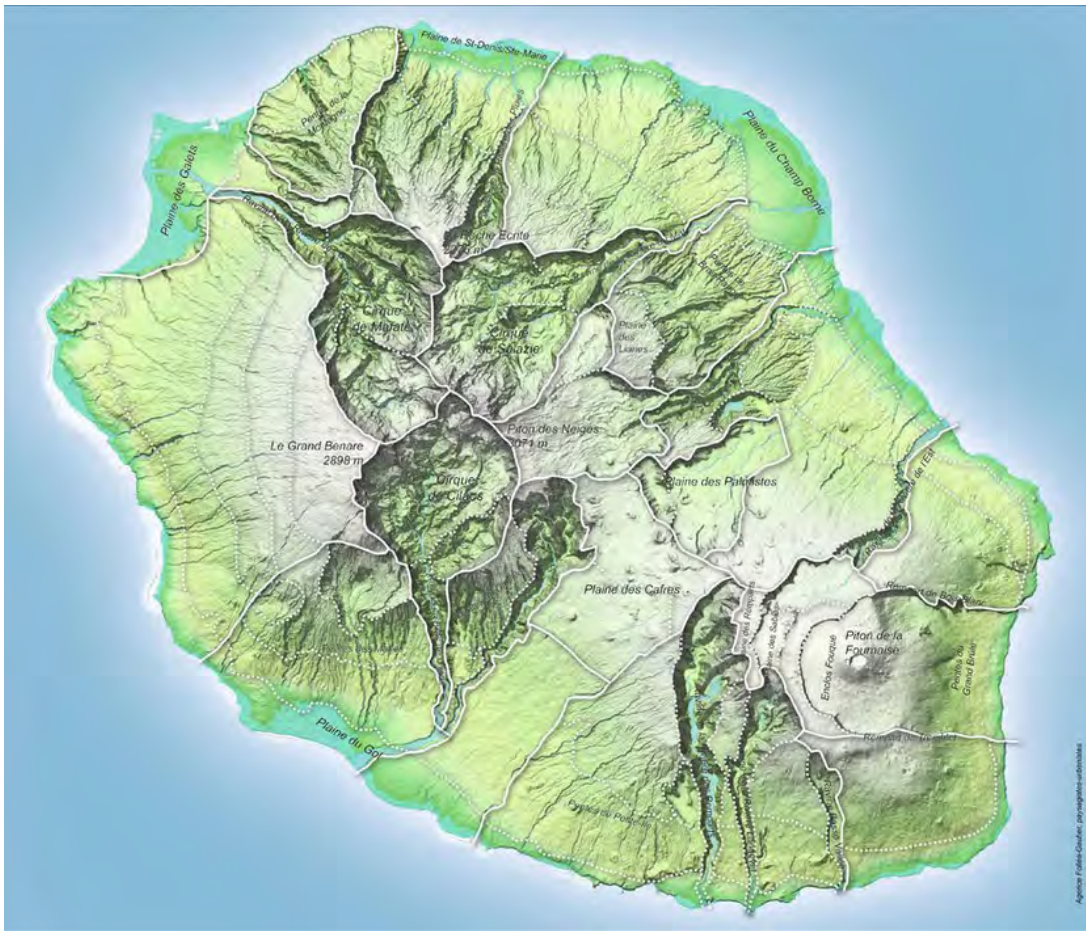
(the variation of atmospheric temperature according to altitude) varies from -0.7 to -0.8°C per 100 m. Given that the relief is so pronounced on the island, the temperature curves follow those of the altitude and create a layered organization of the landscapes, in successive strata.

Finally, cloud cover is an additional ingredient that differentiates the landscapes of the Hauts (highlands) and Bas (lowlands). The clouds cling to the escarpments at an altitude of roughly 900 metres and give a unique rhythm and atmosphere to the Hauts as well as to the spaces between the Hauts and the Bas, the "mid-slopes" (located between 150 and 400 metres in altitude). Bright in the early morning, the sky is filled with clouds for the rest of the day. After being able to view the vast landscape at dawn, the forests and plateaus become misty and humid, offering a completely different image. These mid-altitude territories receive approximately 1,500 hours of sunshine per year, whereas the western coasts experience an average of more than 25,000 hours.

This combination of geographical and climatic variations creates a plurality of living conditions and landscapes. Many small areas isolated from the general environment of the island have heterogenous climatic conditions: around 200 different micro-climates have been recorded across the island! ²



Cloudiness in the Hauts in Bébour, blue sky in the plains

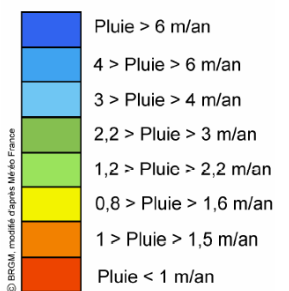


Opposite :

Landscapes and reliefs of Reunion, Atlas des paysages - DIREN/DEAL et Agence Folléa Gauthier

Below :

Reunion Island's schematic rainfall, BRGM, 2005



Numerous risks that impact the Réunionese landscape

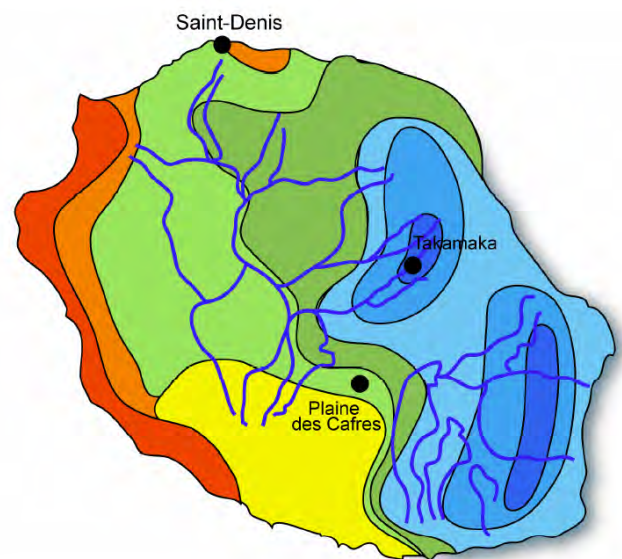
As both a volcanic area and a tropical island, Réunion is affected by numerous natural risks that impact its everyday life and its landscapes.

Every year, a dozen or so cyclones form in the southern part of the tropical Indian Ocean and are thus likely to affect Réunion and its surroundings. Formed during an atmospheric depression and encouraged by the evaporation of a warm ocean (at least 26° C), these whirling phenomena are difficult to predict and are the source of fierce winds and heavy rainfall.

As a whole, the cyclone pattern has a clear influence on the Réunionese landscape. On the one hand, it regularly causes significant damage to nature and buildings, destroying century-old trees and human heritage. On the other hand, it also explains why the gullies are both gigantic in size and modest in the amount of water that usually flows through them: it is only during Dantesque rainfall episodes that the floods substantially fill these large mineral openings.³

An exceptional endemism

Born of volcanism, Réunion has never been attached to a continent. As a result, before man arrived, all the species found there were transported either by sea, wind or birds. Today, there are 856 native plants on the island (those present before the arrival of man), including 232 species endemic to Réunion (present only on the island), as well as many species endemic to the Mascarene Islands. Nowadays, nearly half of the island's plant spe-



cies are of indigenous origin, the other half having been introduced by man.

This natural richness and its uniqueness are remarkable and are the reason why the International Union for the Conservation of Nature has listed Réunion, along with the other islands of the western Indian Ocean, as a "hotspot" for global biodiversity – home to a significant proportion of the planet's species, but a highly vulnerable space as well. In order to protect Réunion's biodiversity and endemism, the Réunion National Park was created in 2007, with its "heart" covering 42% of the island's surface area. This sanctuary zone, which includes the cirques and volcanos, has been listed as a UNESCO World Heritage Site since 2010 under the name "Pitons, cirques and remparts of Réunion Island".

I. The richness and diversity of Réunion Island

B. An island at the crossroads of numerous cultures

1. History: From the discovery of an island to European integration

Discovery of an uninhabited island

On this island, which emerged several million years ago and which is exceptionally biodiverse, no traces of human occupation have been discovered prior to those of the populations that landed in the Middle Ages. The first of these may have been the Arab navigators, who gave it the name Dina Morgabin (West Island; unlike Mauritius, which they named Dina Arobi or East Island), since it appears on Alberto Cantino's map from 1502.

During the Age of Discovery, the Portuguese, Dutch and English passed through; but it was the French who took possession of the island in 1638 before settling there in 1646. The Mascarene Islands then became part of the royal system in the Indian Ocean – a stopover between Madagascar and the Indian trading posts, all of which were managed by the East India Company. The island, at the time called "Bourbon", was described as an idyllic and fertile land, providing the colonists with numerous resources. From the very beginning of the colony, there was a great deal of miscegenation, with the first women arriving on the island being Malagasy or "Indo-Portuguese".

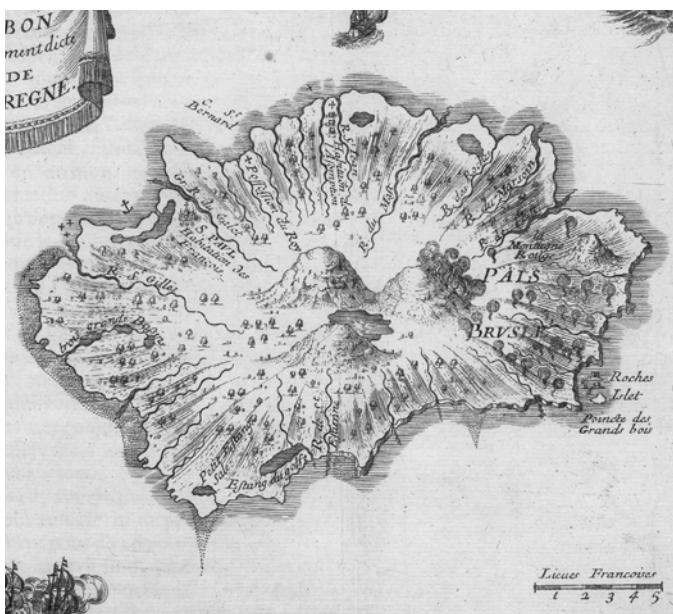
Exploitation of the colony

The exploitation of the island thus began, with the distribution of land concessions to white settlers of French origin. These concessions extended "from the beating

waves to the top of the mountains", linking the coastline to the pitons. This exploitation was made profitable by the intensive use of slavery. Using men from Madagascar, India, West and East Africa, slavery prospered in the 18th century and the island's population grew with it: from 1,171 inhabitants in 1713 to 61,300 in 1789, of which 50,000 were slaves.

The first settlements in the Hauts were made by the "marons", communities of slaves who had fled the inhuman conditions of the farms. They settled – hidden because of the risk of death – in the difficult to access areas of the island and discovered a pleasant climate. They were then joined by the "petits blancs", Réunionese of European origin who had no more land because of the high birth rate, generation after generation.

On 20 December 1848, the decree abolishing slavery was proclaimed at a time when the island had a population of 103,000, of which 60,000 were slaves. This date has since become a public holiday – a celebration and a day of remembrance that is particularly important in Réunion. Immigration and forced labour did not come to an end, however; and until 1933, the practice of inden-



8 First known cartography of "l'Isle de Bourbon", 17ème century



Coffee culture on Bourbon Island, Rosemont, début 19ème century



The escape of marons in L'évasion, Tony de B, Félix, 1844



Straw hut in the 50's, photography by Jean Colbe, collection Y. Patel

tured servitude made it possible to “offer” foreigners a work contract for a renewable period of 5 years in the colony, under difficult conditions and for a paltry salary. This evolution coincided with the development of sugar cane cultivation, which brought prosperity to landowners and became increasingly important in the Réunionese landscape.⁴

Departmentalization

After the Second World War, France’s National Assembly, encouraged in particular by the deputies from Réunion, passed the “Departmentalization” law in 1946. It transformed the former colonies of the West Indies and Réunion into French departments, with the same prerogatives as the departments of metropolitan France. While the French state created important social rights (social security, unemployment rights, etc.), the former colonies initially remained excluded from these advancements. It was not until the 1960s that real modernization and an unprecedented economic take-off took place: improvement of infrastructure and services (transport, health, education, etc.), construction of the Takamaka hydroelectric dam (1968), the first television broadcasts in 1964, etc. At the same time, and following a visit by the Head of State in 1959, a migration policy known as Bumidom was implemented, which was intended to help regulate the population: Réunion’s population grew considerably at a time when a number of other French regions were becoming depopulated. Between 1963 and 1981, 35,000 Réunionese emigrated to metropolitan France, attracted by promises of welcoming conditions that often turned out to be false. The scandal of “The Chil-

dren of Creuse” exposed the forced emigration of 1,600 Réunionese children under this scheme.

Decentralization accompanied the economic development of Réunion and gave it slightly more political autonomy: from 1982 onwards, the Regional Council of Réunion became elected by direct suffrage. With the development of the European Union, the island became a European region in 1992.



School city Lislet Geoffroy in 1967, Saint-Denis, collection Y. Patel

I. The richness and diversity of Réunion Island

B. An island at the crossroads of numerous cultures

2. Réunion in France and Europe: A relationship of dependence

Situated more than 9,000 kilometres away, Réunion Island is today a political entity with multiple affiliations defined by its insularity. The island is a region, a department, an overseas collectivity, an ultra-peripheral region of the European Union and a member of the Indian Ocean Commission. In addition to its many roles, the island nature of Reunion's territory brings with it the problems inherent in insularity and its recurring specificities: "Exiguity, peripherality, limited natural resources, vulnerability to risks of various kinds (political, economic, environmental), dependence on the outside world (...)"⁵. As a result, and as stated by the UN, island territories are special cases for the implementation of development policies.

Dependency on the French mainland for territorial continuity

Today, Réunion is in a relationship of dependence with the outside world and more particularly with its mainland – France. The island is mainly dependent on metropolitan France for its economic, cultural and linguistic exchanges due to certain specificities such as its small size and lack of natural resources.

In 2017, the island's foreign trade coverage ratio (the ratio between the value of exports and imports) was 5.8%⁶. It should be noted that in 1946, this rate was 98%⁷. Accentuated by the Méline law of 1892 (which allowed French products to enter the colonies duty free, while foreign goods were heavily taxed), trade, in terms of both imports and exports, was essentially with France. This reduction in and quasi-exclusivity of trade explains the progressive loss of the island's autonomy and self-sufficiency.

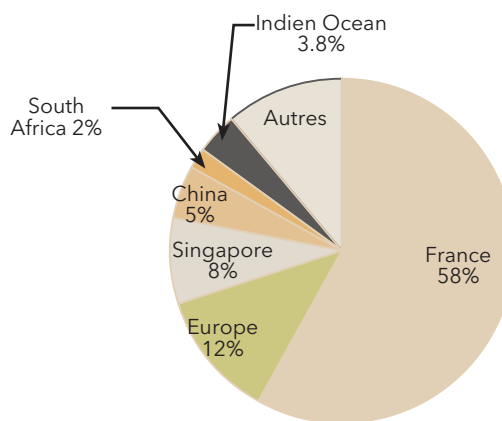
Despite a GDP per capita of roughly 10,000 euros, three times higher than that of Mauritius and ten times higher than that of Madagascar and even Mayotte, it remains 40% lower than that of metropolitan France. And today, 40% of Réunion's population, nearly 330,000 people, live below the metropolitan poverty line⁸, which was 1,041 euros in 2017⁹. These findings are explained by the lack of employment and therefore income. In 2014, only 45% of 15-64 year olds were employed and the unemployment rate reached 56.2% among young people.

Réunion's young population is a real challenge for the territory. It must be built up at a sustained rate in order to meet needs such as education, employment, infrastructure and services. Nevertheless, the economic dynamism since the beginning of the 1980s has not met needs for employment, in particular.

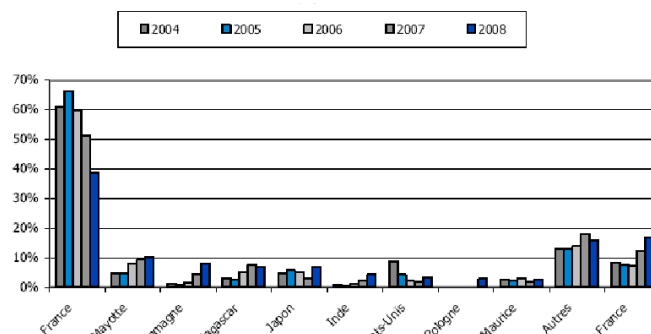
In addition to its economic isolation, Réunion is far removed from international migration. In fact, 83% of the inhabitants of Réunion were born on the island¹⁰ and therefore very few foreigners live there. On the other hand, many people from mainland France come to Réunion to find work and they are the main source



Planisphere, Ile-de-la-Réunion



Main suppliers of La Réunion



Breakdown by country of exported products in %, Customs

of tourism. Air passenger traffic is thus centred around travel to and from Paris.

In contrast, migration to France has always existed but has been reserved for the elite and privileged. It was only in the 1960s and 1970s when the presence of Réunionese people “became strongly visible in metropolitan France with the development of mass migration”. This is how the number of Réunionese diaspora (born in Réunion, or having at least one parent born in Réunion)¹¹ in mainland France is counted.

An ultra-peripheral region of Europe

Réunion has seen an increase in the standard of living and quality of life of its inhabitants, as well as the development of its economy and public services. Despite a leap in its development compared to European regions, it is clear that efforts must still be made to deal with the problem of insularity. Like many island entities, Réunion faces difficulties in terms of health and sanitation infrastructures, access to employment and adaptation to climate change. In fact, Réunion is the third most ecologically deficient island in the world, with a deficit of 2820%, whereas mainland France has a 20% deficit¹².

Within the European Union, the overseas regions are called “ultra-peripheral regions” because of their distance from the European continent. This status enables them to benefit from specific measures within the framework of key European policies such as agriculture, fishing and trade. For this reason, Réunion was allocated €2.2 billion in European funds for the period 2014–2020. Half of this came from the ERDF, the European Regional Development Fund, to support, in particular, adaptation to climate change and investment in urban areas (economic and infrastructure development). These funds aimed to:¹³

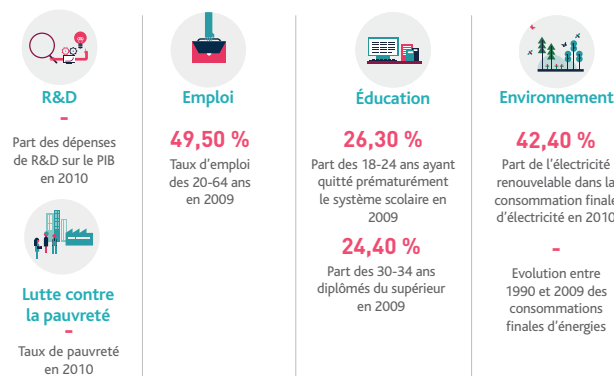
1. stimulate the development of skills, access to employment and social cohesion of the Réunionese population. The strategic priority was to implement a youth pact to promote inclusive growth;
2. invest in the levers of growth and improve the competitiveness of companies in order to infuse the economic fabric with an increased capacity for innovation, the main creator of jobs;
3. optimize the territory’s performance. The aim was to make the island’s environmental capital an asset for its economy, its attractiveness and its capacity to accommodate its demographic growth.

This aid translated, for example, into the development of public transport and soft modes of transport, in order to limit the increase in fossil fuel imports for the transport sector. We can also mention, in the fields of water and waste, that the priorities were the improvement of the quality of water intended for human consumption, through the financing of works intended for the purification of drinking water and the reduction of waste destined for landfills. In this perspective, the actions sup-

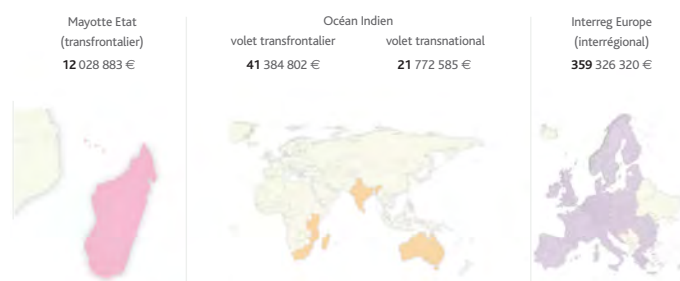
ported were the construction of energy recovery units for waste treatment.

Finally, the island’s cultural context is different from that of other European regions. Réunion is a French region outside Europe. The southwest Indian Ocean region, to which Réunion belongs, does not offer the same opportunities for the pooling of knowledge, regional cooperation and territorial solidarity as Western Europe, to which metropolitan France belongs.

Europe Strategy 2020



Source : « Les territoires français au regard de la Stratégie Europe 2020 », collection Préparer la génération 2014-2020 des programmes européens, septembre 2013, CGET



European territorial cooperation, Partnership agreement, DGEPP

Of its many affiliations, Réunion Island stands out with its twofold approach. On the one hand, the island is considered to be a reservoir of know-how and novel solutions for adapting to climate change for metropolitan France. During the ONERC (National Observatory on the Effects of Global Warming) symposium in 2004, which was devoted to adaptation strategies of local authorities, Paul Vergès, Senator for Réunion and President of ONERC, brought up the interest of the “risk culture” developed by overseas territories. Similarly, Christiane Taubira, Member of Parliament for French Guiana, underscored at the symposium that there was “considerable local empirical knowledge, specific to overseas territories, which should be really developed”¹⁴. On the other hand, and due to its location, Réunion is a well suited relay for disseminating its know-how and showing solidarity with its island and neighbouring territories.

I. The richness and diversity of Réunion Island

B. An island at the crossroads of numerous cultures

3. Réunion in the Indian Ocean: A booming regionalism

In addition to its attachment to mainland France, Réunion has links with its neighbours in the Indian Ocean. The majority of migration to the island comes from the Indian Ocean islands of Madagascar (40% of migration), Mauritius (21%) and the Comoros (11%). Réunion is also part of larger cooperation areas including countries outside the European Union.

Indian Ocean Commission: An island region based on solidarity

Since 1986, Réunion, the voice of France, has been a member of the Indian Ocean Commission (IOC), alongside the Union of the Comoros, Madagascar, Mauritius and the Seychelles.

The IOC is an international organization with an insular and francophone identity. Its member states share the desire to make the organization more dynamic. This ambition was illustrated in 2020 by the revision of the founding Victoria Agreement in order to give the IOC the means to lead collective actions and to give a statutory place to the Summit of Heads of State and Government.

The Indian Ocean Commission's efforts are divided into several strategic areas. They mobilize financial partners as diverse as the French Development Agency (AFD), the European Union (EU), the Green Climate Fund and the World Bank.¹⁵

- Stability and security

In the maritime field, the creation and strengthening of maritime information sharing channels illustrates this area of action. For example, the MASE (Maritime Security) programme has implemented a comprehensive regional architecture for maritime security in the Western Indian Ocean, from Djibouti to South Africa.

- Economic integration of the Commission's island states: Promoting the blue economy, a label for the ethical and sustainable use of the sea

France, through the French Development Agency (AFD), supports and finances the resilience of coastal areas and the protection of marine areas. It includes the Moheli Marine Park in the Comoros and the Mayotte and Glorieuses National Park.

- Environmental preservation and management of climatic and environmental risks

The Hydromet project promotes the importance of building resilience to meteorological, hydrological and climatological hazards. The project's mission is to strengthen the adaptability of services responsible for assessing climate change.

- Health cooperation, beyond the current health crisis, including public health challenges

- Scientific and academic cooperation

The Commission has created the Prix Indianocéanie. This prize, which is a call for written works in French regardless of genre, highlights the talent and creativity of the region's writers and promotes expression in the French language. The 2019 Prix Indianocéanie was awarded to Davina Ittoo from Mauritius for her novel, *Misère*.



Mauritius, the sister island

Geographic neighbours, the “sister islands” of Réunion and Mauritius maintain a close relationship, particularly in terms of cooperation, both environmentally and economically.

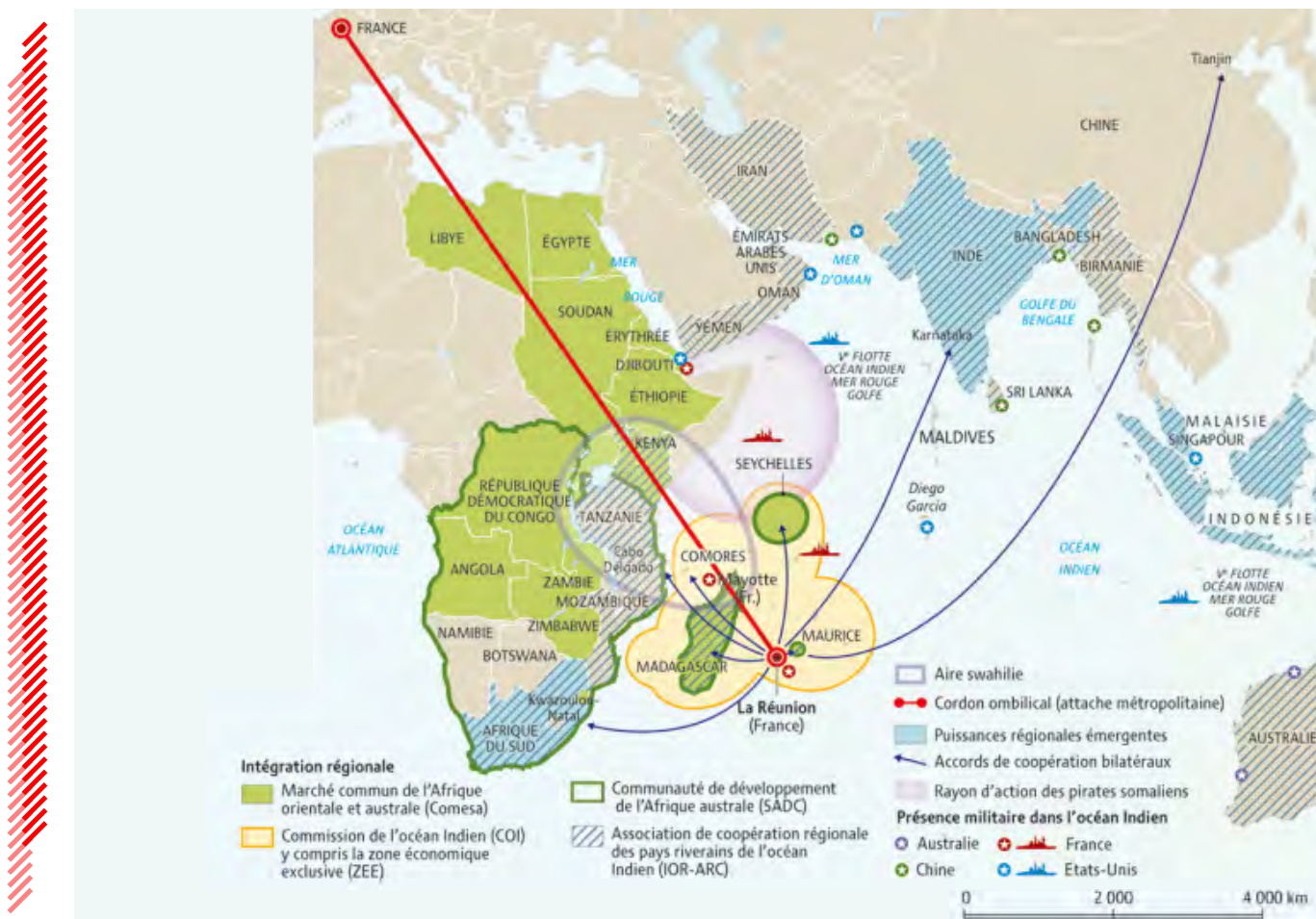
France is a major economic player in Mauritius as it is its 3rd largest trading partner and its primary foreign investor, with 170 French companies, including some 40 from Réunion, employing 14,500 people¹⁶. Moreover, France is Mauritius’ main bilateral partner in terms of official development assistance. Since the reopening of its bureau in Mauritius in 2006, it has been supporting the country in its economic and ecological transition. In return, Mauritius is the leading investor in Réunion. Mauritius also welcomes French tourists, who are its main source of tourists.

The sister islands are active in the field of training, education, higher education and research. Through inter-university cooperation and scholarship programmes, academic and research cooperation is supported. For example, the Hubert Curien partnership supports the mobility of researchers. France also supports in Mauritius, through the Agency for the Teaching of French Abroad, a network of highly reputable French schools (5 establishments, 5,000 students, 2/3 of whom are Mauritian nationals).¹⁷

The Association of Indian Ocean States: A Réunion, Africa, India and Australia relationship

For more than 20 years, the IORA has brought together the neighbouring states of the Indian Ocean, from South Africa to Australia, as well as France, which is recognized as an Indian Ocean country. France joined this organization in December 2020. The IORA is a regional forum that brings together government representatives (academic and economic) with the aim of promoting cooperation and exchange. The relationship is based on the principles of open regionalism. Priority areas are trade and investment facilitation; maritime safety and security; fisheries management; disaster risk management; academic, scientific and technological cooperation; tourism and cultural exchanges; women’s empowerment.

Réunion is emerging as one of the “bridgeheads” of the national territory. It plays a key role in addressing issues of regional cooperation with neighbouring territories. This regionalization of Réunion, i.e. its integration into its natural proximity zone, can be discerned on several levels. The first is with its closest island neighbours – Mauritius, Madagascar, the Comoros and the Seychelles. The second is with the large states bordering the Indian Ocean, such as South Africa, India and Australia.



Sources : Parc national de La Réunion ; Région Réunion ; Comité de bassin de La Réunion ; Office de l'eau de la Réunion ; Insee ; Comité de pilotage de la canne ; Ile de la Réunion tourisme (IRT) ; organisations régionales ; Unosat.

I. The richness and diversity of Réunion Island

B. An island at the crossroads of numerous cultures

4. Creole culture, an alchemy of cultures

Being Creole means being born on the island or in former European colonies, regardless of colour, origin or language. Réunion is characterized by the diversity and miscegenation on which it was founded.

This heterogeneity creates what is called “living together”, giving it both its meaning and its enduring legacy.

The concept of “living together” that characterizes the island is embodied by the diversity of origins, languages, cultural and religious practices and their dialogue in the social and cultural space of those who have come and continue to come to the island. It is the meeting of several worlds – from the islands of the Indian Ocean (Madagascar, Comoros) to southern Africa, and from France and Europe to Muslim India, Dravidian India and China.

Creoles make up the largest part of the Réunionese population (40-50%). They originally came from the Indian Ocean (Madagascar, Comoros) and southern Africa (Mozambique, Guinea), and are often mixed with whites. The Comorians are essentially from Mayotte, and today represent between 4% and 6% of the population. Cafres refer more specifically to blacks, but this term is often confused with Creole. They are mostly Catholics.

The Malbars are originally from southern India and represent 20% to 25% of the population. Practising Tamil Hinduism, they came during the large waves of immigration required for the plantations after the abolition of slavery on 20 December 1848.

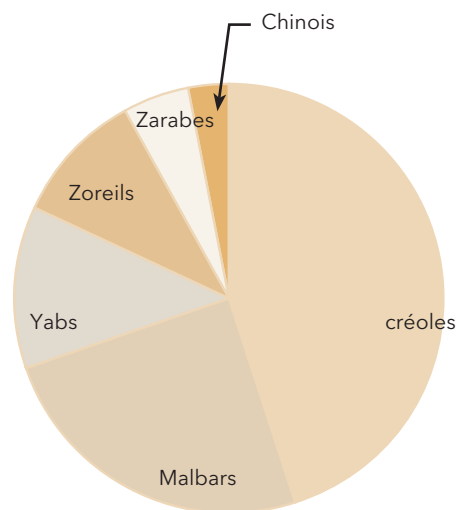
The Yabs, also known as the “petits blancs des hauts”, are the descendants of white settlers who went into exile in the highlands, and today they refer more specifically to the white Creoles of the highlands. They represent about 10 % to 15% of the population.

The Zoreils refer to the metropolitan population and represent 10% to 15% of the island’s population. By extension, the term Zoréole is used for metropolitan people who have been living in Réunion for a long time. Conversely, the term Kréopolitains is used for Creoles who have been living in metropolitan France for a long time.

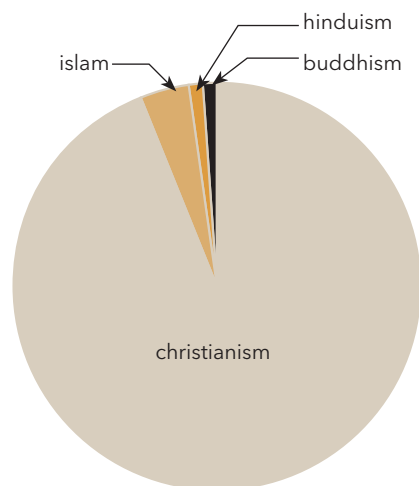
The Zarabes in Réunion are immigrants from Western India who arrived in the 19th century. They are Sunni Muslims and represent about 5% of the population. The Karanes are Indians who initially emigrated to Madagascar and then to Réunion Island.

The Chinese arrived in the 19th century and are essentially from the Guangzhou region. The Chinese are generally Catholic but they also celebrate traditional Chinese religious festivals with great fervour. They make up about 3% of the population.

The island is therefore a contact zone, a space of creolization. It is a place in which people who, because of their societies of origin and their own migratory routes,



Reunionese population



Religions in La Réunion

already have an understanding; a practice of borrowing and exchange, of building together over time and in a constantly renewed manner; a way of life based on sharing, negotiation, dialogue, tolerance and solidarity.¹⁸

Creolization gives rise to singular socio-anthropological configurations, both in terms of material and immaterial productions and in terms of forms of living together. Consequently, there is now the notion of "creolité". Originating in Martinique between the end of the 1980s and the beginning of the following decade, creolité is an anthropological and historical reality. It is removed from racialological ways of thinking and from the idea of a single identity. Belonging to a community, signified by birth, miscegenation, the transmission of a mother tongue and culture is what defines creolité.¹⁹

The official language in Réunion is French, but the main language spoken by the population is Creole. Creole has been used since the beginning of the island's colonization due to the need to be able to communicate with people from different backgrounds. Creole has evolved over the course of history as it has been enriched by Tamil and Malagasy contributions. Creole remains above all a spoken language.

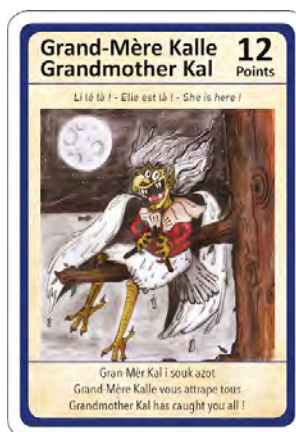
The complexity of anthropological situations is one of the foundations of the Réunionese Creole world. Through culture – such as cooking, music, poetry (*fonkèr*) and dance (*maloya, narlgon, karmon*) – various languages and cultures intermingle, with an amalgam of legends and ancestor cults arising from the confluence of African, Malagasy, Hindu and Catholic influences. A well-known legend, Grandmother Kalle, is a Réunionese legend that dates back to the time of slavery. Many stories are told about this frightening character, but everyone agrees that this old woman with a long hat is a harbinger of misfortune and a practitioner of witchcraft. All Réunionese children know of Grandma Kal, who is still invoked today if they are not behaving. Another cultural practice known to all is *ladilafé*. This art of gossip highlights the island's oral tradition and culture.



Traditional danse, tourisme Réunion



Jace, gouzous en poupées russes, © 2021 SARI



Illustrated card by Aurélie Lagrange (© Orphie)



Mickaël Elma, without title, manière noire



Fresco mural by street-artist Méo

I. The richness and diversity of Réunion Island

B. An island at the crossroads of numerous cultures

5. Living in and with the nature

Understanding the relationship of one space to another helps to determine a cultural and social identity. In Réunion, the characteristics found between the public and the private, between the interior and the exterior, or between the owner and the stranger, structure and codify the spaces of any property. Through the architecture, the organization of the garden, the colour of the *kaz*, the ornamentation and the elements of worship, a way of life specific to the Réunionese is defined: the Creole way of living with the *kaz atèr*.

Properties are composed of several elements, including:²⁰

The Creole garden is a garden on full display from the public space. Like the island's flora, the Creole garden is

made up of dense and luxuriant vegetation combining varieties of plants, flowers and fruit trees. It can be equipped with a *guétali* (a raised kiosk and mini outdoor living room overlooking the street). Visible from the public space, it is delimited by an openwork or plant fence and by the *baro* (gate).

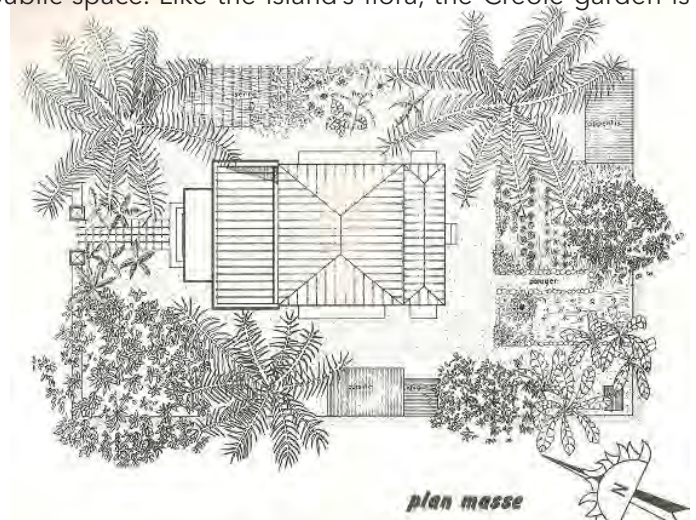
The varangue is a reception area that protects users from the sun, rain and wind while still being outside. Like a veranda, it is used as living as space.

The kaz or case is the family and private space. It is a wooden construction covered with shingles or metal sheets. Constructed with a block plan, meaning it is rectangular, the Creole kaz is covered by a four-sided roof. The Creole kaz can evolve according to its owner's means and needs.

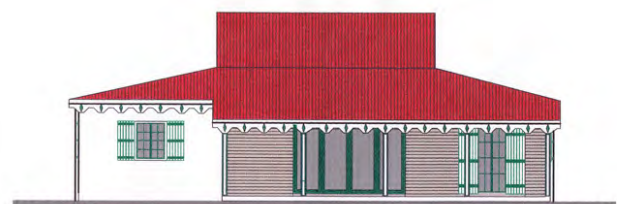
The courtyard is the domestic space. Located in the back, the courtyard has a dirt floor and contains the kitchen and other outbuildings, animals and edible plants. This part is reserved for close family and friends.

Réunion's architectural heritage blends richness and variety in the image of its population, while also having developed specificities linked to its insular setting and climatic conditions (heat, humidity, wind, cyclones, etc.).

Pailloles were the first form of dwellings on the island.



The garden and case Creole, PATVAL



Facade of case creole, Michèle Robin-Clerc



Photography of creole garden and varangue, PATVAL



Case in Entre-Deux, with colorful wood, CRDP de La Réunion

They were made of locally available materials such as calumet bamboo, vacoa (*Pandanus utilis*), palms, vetiver, etc. Then, with the arrival of the first settlers, the first real Creole kaz with wooden frames were built. The straw hut remained one of the most common forms of housing in Réunion until the departmentalization of the island. Today, only a few examples remain in certain isolated islets of Mafate and Cilaos. From the middle of the 18th century, buildings modelled after the French style were built. The Adam de Villiers house in Saint-Pierre is a good example of European influence on Réunionese architecture, integrating multiple heritages inspired by neoclassical, colonial and Indian styles.

The transition from the traditional Creole kaz (*kaz atèr*) to collective architecture with rows of housing blocks and towers (*kaz anlèr*) appeared in the 1960s in response to concerns of insalubrity and the demographic explosion. This change generated profound upheavals in Réunionese society. Indeed, these habitats were created on the same models as those of post-war France, with no connection to the towns and cultural habits of the island.

In parallel, and during the island's short periods of prosperity, remarkable houses were built such as the Valliamé house in the Creole art deco style. From the 1960s-1970s until today, the Tomi case and the SATEC case have contributed to the democratization of a vernacular habitat architecture.

In addition to the architecture, which reflects the importance of nature within the habitat, there are many customs and traditions related to nature in Réunion. *Bichique* fishing as well as the practice of picnics are examples of the outdoor activities enjoyed by the Réunionese people.

Bichique fishing is the fishing of small red-tailed goby fingerlings (aka *cabot tête de lièvre* or *cabot bouche*). They lay their eggs upstream in the rivers and are then carried by the current to the ocean. It is there that, from October to March, fishermen try to capture them in the mouths of the rivers with conical nets, called *vouves*, which are arranged by forming a channel that retains the bichiques (fingerlings). Bichiques are very popular in Creole curry dishes and are very expensive.

Picnics are a tradition in Réunion. Throughout the year, whatever the season, on weekends or during school holidays, the Réunionese share in this convivial moment together. Gathered around traditional Creole dishes, such as *cari* or *rougail*, Réunionese enjoy the island's many picnic and leisure areas.



Engraving by J.-B. Bory de Saint-Vincent, Case à la Rivière d'Abord, 1802



House Valliamé, CRDP de La Réunion



The Tomi case, 350 ans d'architecture à l'île de la Réunion, CAUE



Pond of Saint-Paul and fishing, ImazPressRéunion



The coconut grove and picnics, ImazPressRéunion

I. The richness and diversity of Réunion Island

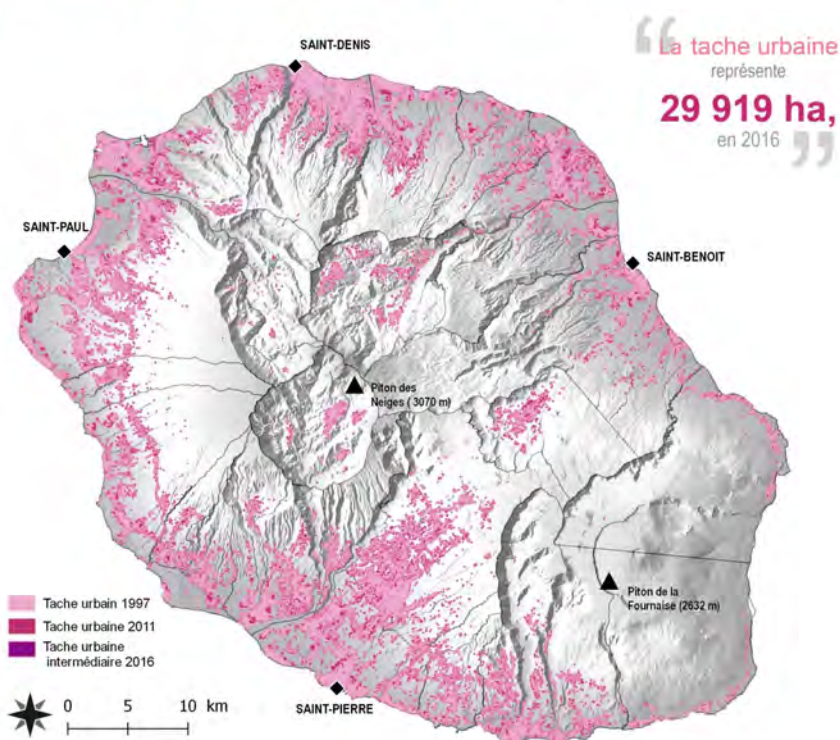
A. A heterogeneous occupation of space

At the crossroads of several worlds, Réunion's urbanity is inspired by multiple architectural identities (Western and Eastern) that have led it to define its own composition and urban form. This is why Creole urban planning is so rich, alternating between historical grid patterns, linear towns following railway tracks, seaside resort complexes, and scattered towns and islets in the Hauts. Creole urbanism combines architecture marked by cultural influences and a rich and varied nature that coexist on a restricted and constrained island territory.

"The issue of densification is particularly relevant in Réunion due to its island context: scarcity of land, preservation of the natural and agricultural heritage and the fight against the dysfunctions generated by urban sprawl. The Regional Development Plan, supported by the Region, makes the balanced consumption of space a major axis of the regional development policy. In the same vein, one of the primary objectives of the White Book for the Sustainable City of Réunion, drawn up by the State, is to develop the assets of [the] territory by putting an end to the excessive consumption of natural and agricultural areas. However, the concept of density is subject to strong prejudices, and preconceived ideas can be a deterrent to local authorities and citizens in developing ambitious territorial projects that converge towards this objective."²¹

Every year, urbanization increases by 500 ha, and the urbanized land area (i.e. tâche urbaine, the physical inscription of urbanization within the territory) grows by 20% every 10 years, nibbling away at the island's agricultural and natural areas. Moreover, the density of housing in Réunion is low, at 10 to 12 dwellings per hectare. Urbanization in Réunion is composed of 75% of individual houses. Réunion is not dense and is sprawling further out, with numerous consequences.²²

Artificialization and the sealing of soils weaken natural environments by increasing floods and fires. The increase in carbon-based mobility and spatial distribution leads to energy consumption and pollution. Poor management of public financing for facilities, particularly for social and environmental services, leads to significant additional costs. Installing utility networks in sparsely populated areas is 3 to 5 times more expensive than in densely populated areas. It is estimated on average that it costs €25,000 to equip a house in the suburbs with utilities, compared to roughly €6,000 in the centre. The "all-car" tendency and urban sprawl result in a degraded and discontinuous landscape.²³



Evolution of the urban task between 1997 and 2016, IGN / Agorah 2015

1. An urban framework marked by “macrocephaly”

Due to its physical characteristics and its history, Réunion Island has a peripheral urban network which highlights a two-fold imbalance in its territory. In this context, the geographical centre of the island is therefore defined as a periphery, while the coastal periphery is clearly the dynamic centre, supported by a relatively well-structured distribution and circulation network.

Réunion’s urban framework is dominated by its largest urban agglomeration, Saint-Denis, with 149,313 inhabitants. Its macrocephaly or hyper-centralization, in addition to its economic and cultural dimension, is explained by the fact that Saint-Denis is at the same time a departmental capital, a regional capital and an island capital. The second-tier city, Saint-Pierre, is considered a regional centre of balance in the south. It has only 85,083 inhabitants. Then, at the third level, there are six medium-sized towns on the scale of the island: Le Port, Saint-Paul, Le Tampon, Saint-Benoît, Saint-André and Saint-Louis. They range from 34,000 to 80,000 inhabitants. Then, the towns of Sainte Marie, Saint Joseph, Saint Leu, Possession and Saint-Gilles-les-Bains make up the next stratum with populations between 33,000 and 38,000 inhabitants. They are then followed by Les Avirons, Bras-Panon, L’Etang-Salé, Petite-Ile, Saint Suzanne, with populations between 10,000 and 23,000 inhabitants. Finally, the last stratum includes towns with populations between 2,000 and 10,000 inhabitants: Cilaos, Entre-Deux, Plaine des Palmistes, Saint Philippe, Saint Rose, Salazie and Trois Bassins.²⁴

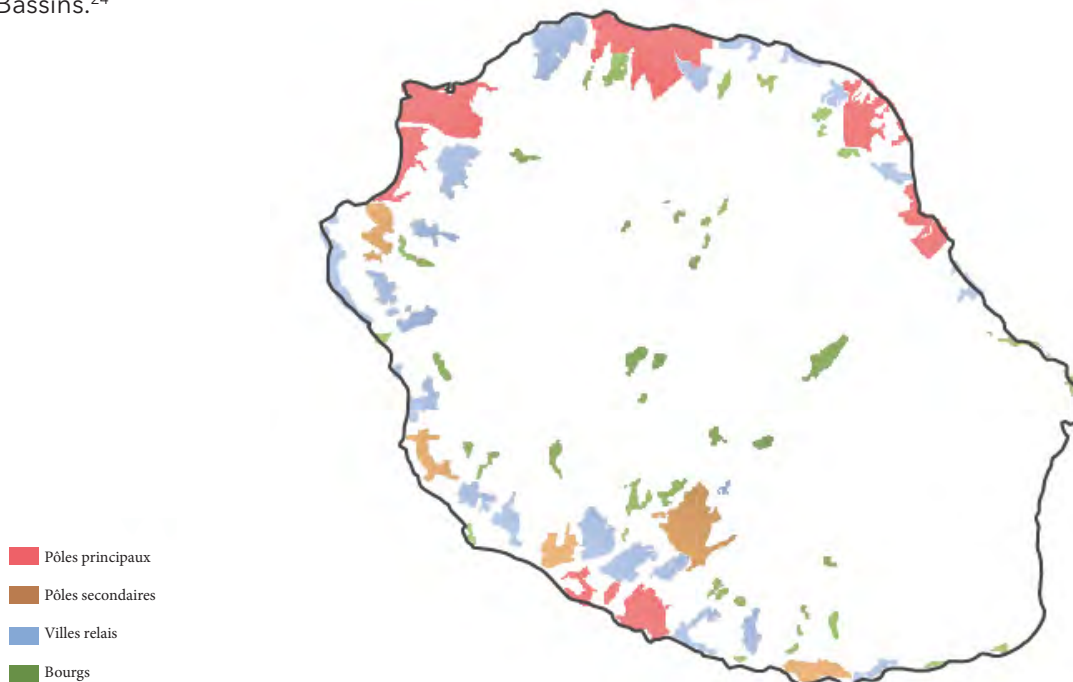
The first imbalance lies within the coastal region itself. Four urban sections stand out:

The first section is that of the northwest. It combines the macrocephaly and dynamism of the capital Saint-Denis with that of the industrial city of Le Port, some twenty kilometres away. It is the lung of the island.

The second is located in the south. It is centred around the town of Saint-Pierre. As a sub-prefecture and because of its commercial and administrative function, Saint-Pierre is a real regional centre.

The third section is the western coastline. It includes Saint-Paul, Saint-Gilles-les Bains and Saint-Leu. Urbanization here has benefited from the construction of facilities and infrastructures, particularly the modernization of the road network (Tamarinds Road), in connection with the development of tourism in the area as a seaside resort setting.

The fourth and last section is located in the northeast. It is notable for its relative “delay” in urbanization, mainly due to the very strong hold long held by large sugar plantations. This area is characterized by a bi-polarization of the space by two medium-sized central cities, Saint-André and Saint-Benoît, who now share complementary functions, after having long been competitors.²⁵



I. The richness and diversity of Réunion Island

C. A heterogeneous occupation of space

1. The Bas and the Hauts, opposing spaces

In addition to the relative macrocephaly of Saint-Denis, the second imbalance lies in the dichotomy between the Bas, i.e. the coastal region and the low slopes (altitudes below 150 m) and the Hauts (external slopes above 400 m, the Plaine des Palmistes and Plaine des Cafres plateaus and cirques). The mid-slopes are located between the Hauts and the Bas (between 150 m and 400 m in altitude).

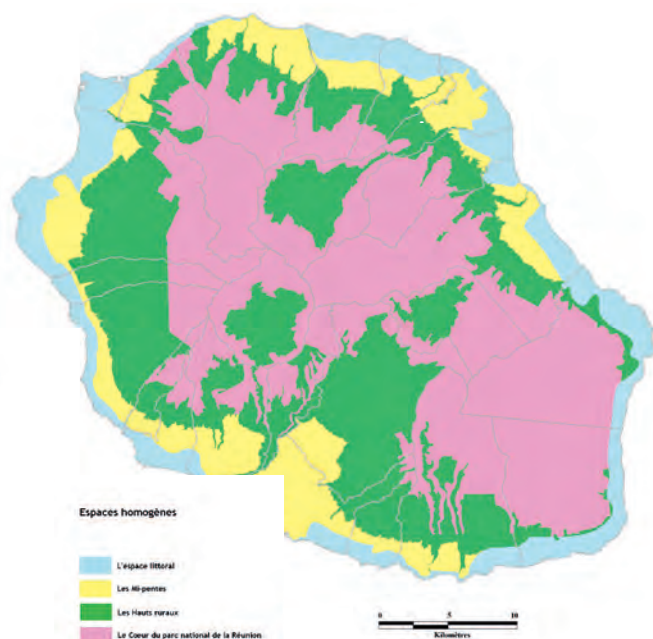
The Bas is highly urbanized. This lowland area includes a dozen or so towns and makes up the upper strata of the urban framework. Equipped with a structured road network, the Bas constitutes an important employment basin. The Bas concentrates all of the island's economic activities, especially services. At the opposite extreme of this diversity of service activities, industrial activities and those linked to water, energy and waste are rare. Indeed, these typologies often take the form of large structures but are nevertheless few in number.

A territory with a mountainous relief, the Hauts of Réunion encompasses a significant part of the island with an estimated surface area of nearly 2,000 km², or 75% of the territory. Nonetheless, the Hauts is underpopulated (less than 3% of the island's population) and under-urbanized.

The mid-slopes are home to sugar and fruit farming as well as woodworking. The mid-slopes are subject to pressure from the urban sprawl of coastal towns and the mountainous terrain of the Hauts. For example, the Tamarinds Road has facilitated access to these areas, allowing for the urbanization of this section of the landscape. Individual housing is highly developed with 80% of households living in a single-family house.²⁶

In terms of the economy, the Hauts of Réunion is home to fewer companies than the Bas and is mainly involved in business activities. Despite the fact that agricultural activities are widely present in the Hauts, service activities are also numerous, with a growing shift towards the tertiary sector. It is in the mid-slopes that the population is best integrated into the labour market.

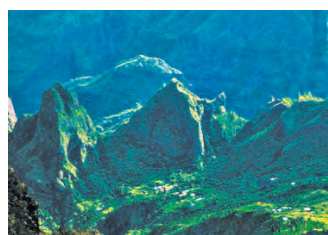
The entire territory of Réunion is seeing a shift towards tertiary activities. This is why it is important to structure this development in order to find a balance between the supply of services and the needs of the population. In addition to the urban and economic dimension, the opposition between the two regional entities also has a human dimension. The socio-psychological divide is rooted in the history of the occupation and development of Réunion. The slightly more devaluing image given to the Hauts, which is remote and backwards, acts as a repellent and consequently hinders some attempts at the densification of the Hauts' towns.



Coastal areas



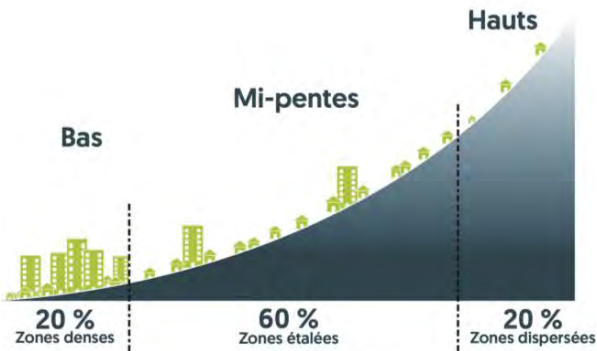
Rural of the Haut



The heart of La Reunion
SAR de la Réunion



The mid slope



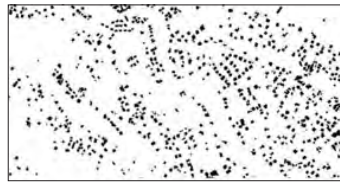
Conceptual diagram of urbanization in La Reunion, Agorah



Photography of Possession and Port, SAR



DENSE AREA



SPREAD AREA



SCATTERED AREA



Photographs of the different areas, assessment of the implementation of the SAR

Islets such as Mafate highlight the uniqueness of the territory

The islets of Mafate offer a timeless setting and a glimpse of life away from civilization in a unique environment. However, the people of Mafate have difficult living conditions. The isolation and accessibility of the sites are the first constraint of Mafate. Some of the Mafatais have to walk long distances to get to school or work. In order to supply themselves with resources, the Mafatais have two means of travel: walking or by helicopter. Weekly rounds are made to supply the islets. With 700 inhabitants, the Mafatais use local natural resources for water and electricity through solar energy. Each inhabitant cultivates his/her own vegetable garden and owns a few animals. The Mafatais' only economic activity is tourism.



Skyview of the village in Cilaos ©-Serge-Gelabert

I. The richness and diversity of Réunion Island

C. A heterogeneous occupation of space

2. Landscapes structured by island economic activities

Since 1946, Réunion's economy has undergone major transformations. The island has gone from being a poor economy based on sugar monoculture to a modern economy, one of the most advanced in the Indian Ocean. However, this economy is not without its vulnerabilities.

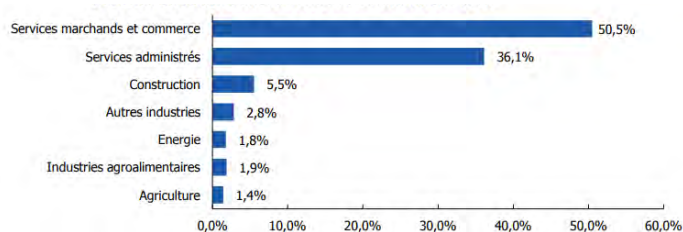
A developed economy still dependent on the mainland

The tremendous growth of the Réunionese economy over the last fifty years is unquestionable: between 1970 and 2010, GDP increased more than 60-fold in value, from 306 million to 19.6 billion euros. The GDP per capita has followed the same trend, from €213 in 1960 to €22,900 per capita in 2019.

Like most modern economies, Réunion is highly service-oriented. Although agriculture dominated prior to the island's departmentalization, services now account for over 85% of the island's GDP.

This strong growth has been sustained by household consumption, public administration and investment, all three of which are strongly supported by public transfers: the Réunionese economy is highly dependent on funds from the French state. These transfers have created a solid but limited local market, which supports the island's economy.

As a result of this situation and the absence of certain commodities on this small island, Réunion suffers from an extremely negative trade balance. Imports represent almost 5 billion euros, while exports are around 500 million euros. Another factor which demonstrates the fragility of the Réunionese market is that only 51% of Réunionese of working age are employed (64% in mainland France). Although it is the driving force behind job creation, the commercial sector is particularly weak – it employs 32% of Réunion's population compared to 44% in mainland France. Jobs are scarce in industrial sectors (other than agri-food), business consultancy, finance and insurance, information and communication, and sectors with high productivity. And this is not compensated for by the over-representation of the commercial and hotel-restaurant sectors.



Emblematic traditional sectors

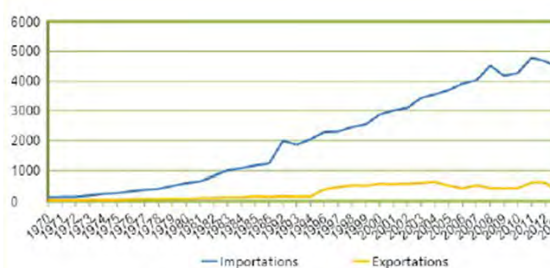
Sugar cane, a pillar of Réunion's export industry and landscape

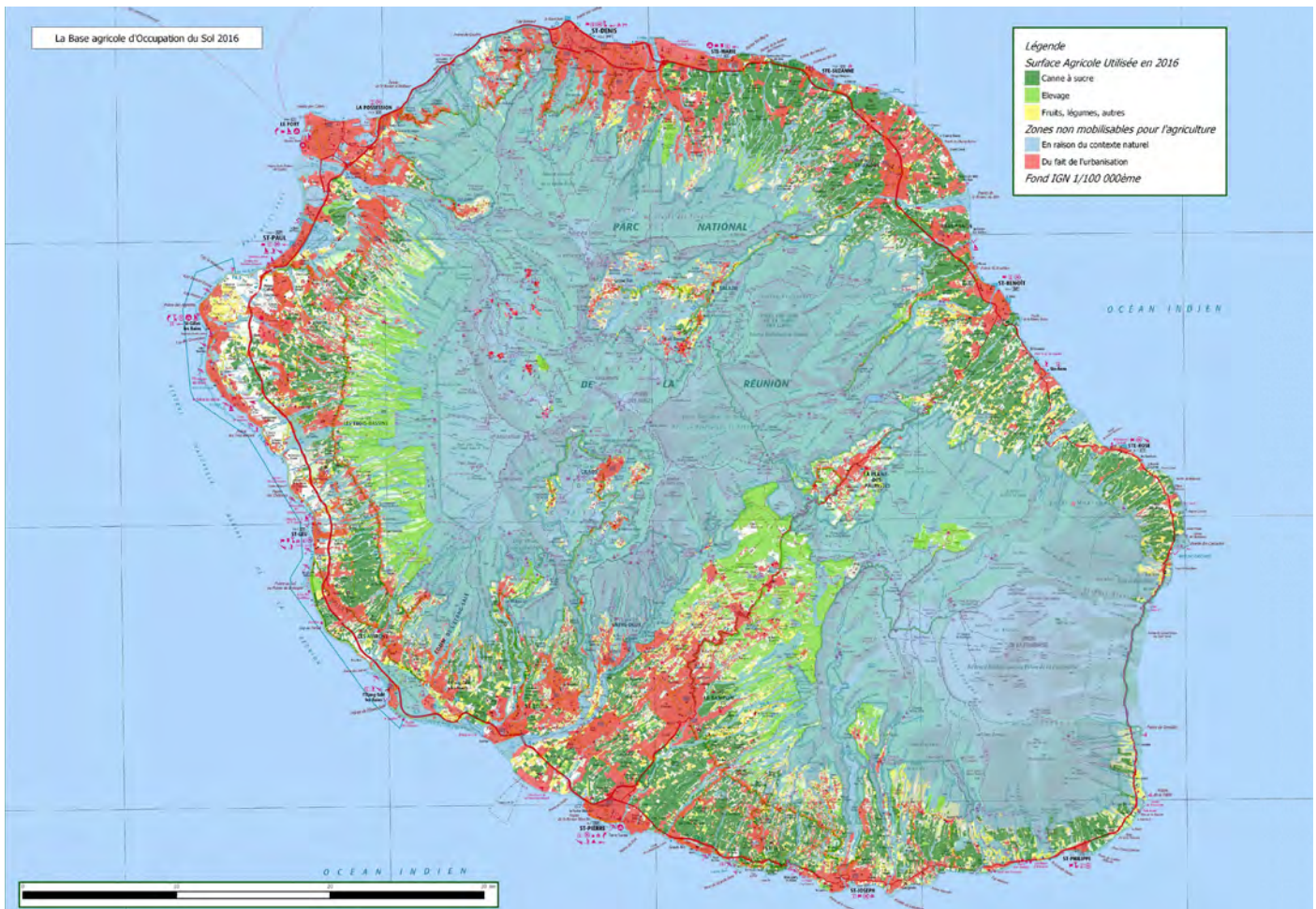
When Réunion was first colonized, the island was initially specialized in the cultivation of coffee. In the 19th century, Réunion's economy became entirely based on the sugar cane industry. Today, sugar cane is still at the heart of Réunion's agricultural sector. Although its weight in Réunion's GDP is low (agriculture only accounts for 3% of GDP), the cane sugar-rum sector accounts for half of the value of exports. The sector is also a major provider of employment, representing more than 18,300 direct, indirect and induced jobs.

Sugar cane is everywhere on the island: the agricultural sector covers roughly 23,000 ha (54% of the utilized agricultural area). Its surface area is decreasing from year to year. The sector also has 13 reception centres (the "balances"), 2 sugar factories and 3 distilleries. The sugar factories, Le Gol and Bois Rouge, belong to the French sugar group Tereos, the second largest sugar producer in Europe.

Bagasse, the fibrous residue of sugar cane once the juice has been removed, is then used to fuel biomass thermal power plants on the same sites (and thus provides approximately 10% of the electricity produced on the island). The ash from the burning of bagasse is also used as fertilizer.

Nevertheless, the sector is fragile: the end of the European sugar "quotas" in 2017 (the European Union imposed production levels to guarantee a minimum price) made prices volatile and directly affected sugar producers. The sector is also dependent on public aid and therefore on the Common Agricultural Policy managed by the European Union, which is renegotiated every five years. Finally, the major players of the industry





Land use in 2016, Direction de l'Alimentation, de l'Agriculture et de la Forêt de La Réunion

emphasize the fact that sugarcane must be produced in large quantities to be profitable: the decrease in its surface area on the island cannot continue without affecting the viability of its production.

The rest of the agricultural sector is dominated by the production of fruit and vegetables, which is constantly growing and is encouraged by public policies favouring local agriculture and livestock farming, in particular the pork, poultry and dairy sectors, which have notably developed in the Hauts.

Blue economy

Réunion is one of the main nerve centres for the organization of the fishing industry in the Indian Ocean. In its broadest definition, the blue economy employs nearly 7,500 people in Réunion, i.e. 2.9% of total employment on the island. The pillars of this sector are tuna and swordfish. Réunion is also the support base for fishing in sub-Antarctic waters (economic zones excluded from the French Southern Territories), where high-value species such as toothfish and lobster can be found. Fish processing in Réunion remains modest (4 companies and 42 jobs in 2015) and is concentrated on swordfish.

Tourism

A tropical island with exotic landscapes, Réunion has the makings of a top tourist destination. Although tourism is an important sector for the island's economy, it remains modest compared to other islands such as the Seychelles or Mauritius. Tourism activities account for 7% of

Réunion's GDP, but these activities are highly dependent on the local market: more than half of tourist expenditure is made by local visitors. As for tourists from outside of the island, the majority of them are "affinity" tourists, who come to visit their relatives. In total, 81% of external tourists come from metropolitan France, leaving a small share to the rest of Europe and Mauritius. Regional tourism, coming from the Indian Ocean, is therefore little developed as it is.

Economic strategies geared towards sustainable development

Directions for Réunion's economy, corresponding to current challenges, can be seen in several strategic documents, notably the Regional Economic Development, Internationalization and Innovation Plan (2017), the Convergence Plan drawn up between the State and local authorities in 2019, and the development project "Vive la Réunion 2021-2027" by the MEDEF Réunion (a major employers' union). These strategies highlight the importance of better integration in the regional basin, of being a pioneering territory in terms of eco-activities and the energy transition, and of working towards social cohesion in order to develop employment.

The year 2020 and the pandemic had a major impact on Réunion (-28% of activity during the March 2020 lockdown) and in particular on the tourism sector, although the French State has put in place major support measures to act as a buffer.

I. The richness and diversity of Réunion Island

C. A heterogeneous occupation of space

3. Territorial actors: The administrative “millefeuille”

Réunion is therefore characterized by a significant presence of the public sector and its institutions, which have a certain influence on its territories. In France and in the French overseas territories, there is a hierarchy of levels and authorities often referred to as the “administrative millefeuille”: there are many players of varying jurisdictions, which means that citizens and companies have a large number of structures to deal with. Réunion is also unique in that it is both a French region and department, whereas a region usually contains several departments in mainland France.

The State

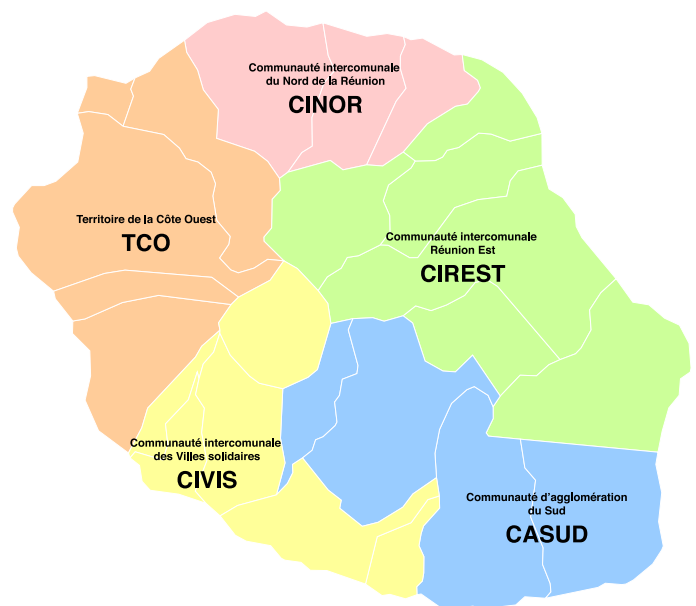
The State is obviously essential. Within the French government, the Ministry for Overseas French Territories coordinates the action of the French executive in its territories outside the “hexagon”. Its current representative is Sébastien Lecornu. The decentralized services of the State, which enforce national policy on the ground, are those of the Prefecture, whose offices are in Saint-Denis. Among the laws recently adopted by France that will have an important impact on land-use planning, it is worth highlighting the Climate and Resilience Law (adopted this summer), which includes provisions regarding soil artificialization: from 2050 onwards, the “Zero Net Artificialization” objective will impose strict measures to conserve expanses of natural and agricultural land within French municipalities. In addition, the rate of new development is to be halved within two years.

The Region

The Réunion Region is an overseas region. The Regional Council, which has been elected by direct universal suffrage since 1982, exercises the powers of a French region as well as certain powers specific to overseas regions, notably in the areas of economic development, vocational training, transport, secondary schools, regional cooperation and the management of European funds. The Regional Council draws up and implements the Regional Development Plan (Schéma d’Aménagement Régional, SAR), which sets out the fundamental guidelines for the territory in terms of land use, sustainable development and environmental protection. This plan is imposed on all other planning documents prepared by smaller government authorities and applies for 10 years. The Regional Council is currently headed by Huguette Bello, who was elected at the end of June 2021.

The Regional Development Plan, adopted in 2011 has four objectives: to meet the needs of a growing population while protecting natural and agricultural areas; to strengthen the cohesion of Réunionese society in an increasingly urban context; to strengthen the economic dynamism of a united territory; and to secure the functioning of the territory by anticipating climate change. In particular, it plans to significantly limit urban sprawl and to favour the densification of existing urban and peri-urban areas, specifically by building in “hollow spaces”. The SAR also defines a hierarchical urban framework based on centres, intermediate centres and local towns. A chapter is devoted to the “Schéma de Mise en Valeur de la Mer (SMVM)”, which aims to protect coastal ecosystems, organize activities and contain urban development in coastal areas.

The Department



The five inter municipalities of Reunion, wikipedia

The department is one of the older tiers of government in France, and is also a directly elected authority. Its main responsibilities are social action, employment and the administration of secondary school. It also shares responsibilities with the region in the fields of the environment, culture and tourism. The Department of Réunion, led by Cyrille Melchior since 2017 and who was re-elected in 2021, has developed the Ecological and Solidarity Transition Plan, which calls on local governments to demonstrate eco-exemplarity and to implement public policies aimed at accelerating the ecological transition in a spirit of solidarity.

The inter-municipalities

Public establishments for inter-municipal cooperation (EPCIs) are French administrative structures which bring together several communes in order to exercise some of their powers collectively. Réunion has five EPCIs, corresponding to distinct geographical areas of the island, linking the coast to the Hauts. The inter-municipalities are at the head of the list for spatial planning, urban transport, economic development, the organization of waste treatment and tourism. They draw up Schémas de Cohérence Territoriale, framework documents for regional planning, which must be in accordance with the Schéma d'Aménagement Régional. EPCIs are governed by a Communal Council and a President, elected indirectly by the teams of the communes that are members of the intermunicipal body.

The communes

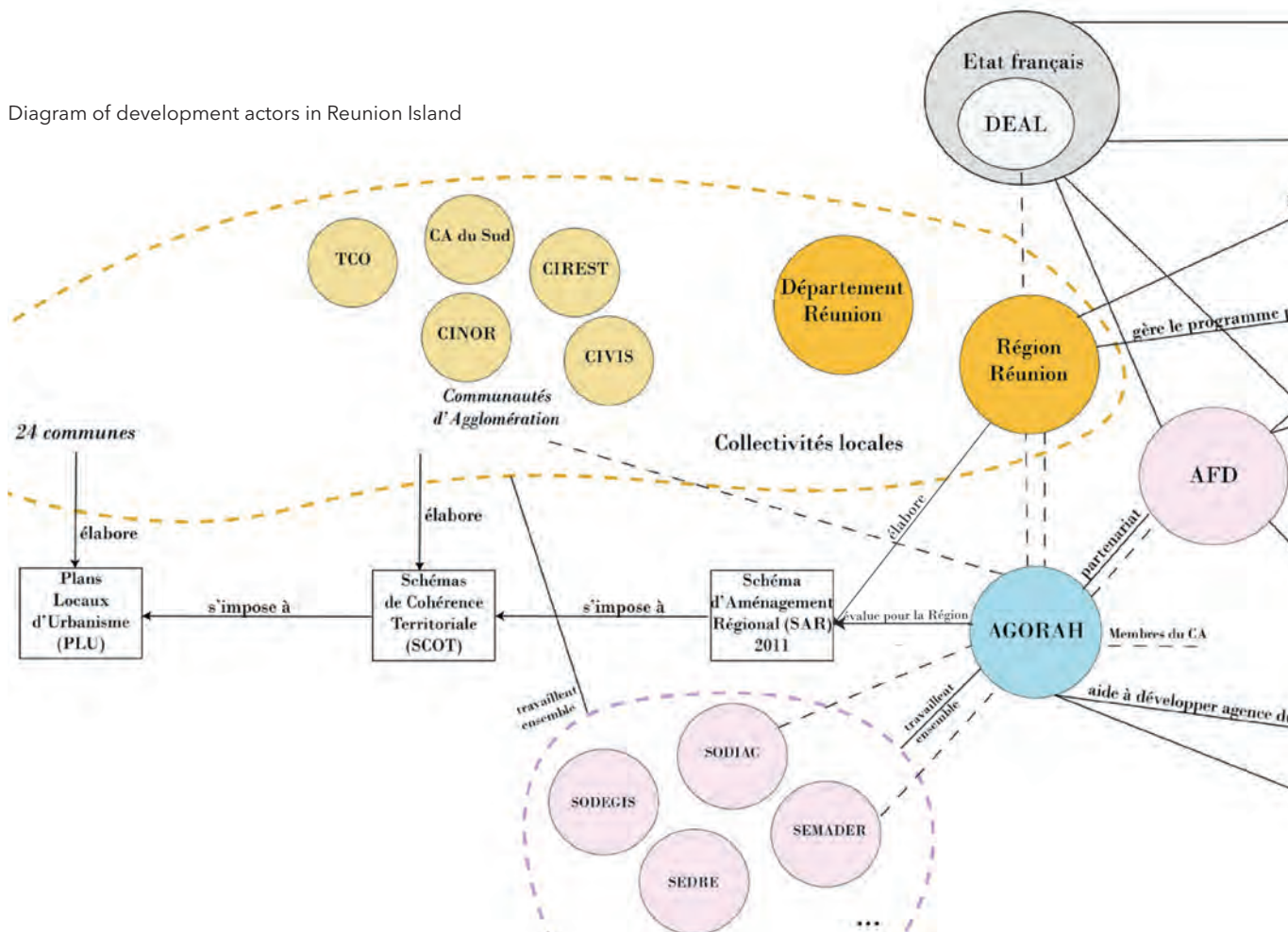
The communes are the smallest tier of government in France, and are run by mayors and municipal teams elected by direct universal suffrage. They are responsible for local administration (civil status, water management, building permits, etc.) and the organization of daily life. In particular, they draw up Local Urban Plans, which define land use and must comply with the Schéma de Cohérence Territoriale.

Among the other actors of territorial development, it is also important to note the importance of the Sociétés d'Economie Mixte, semi-public companies created by the State or by local authorities to manage public land, to carry out development operations or to operate public services of an industrial or commercial nature.

ROPrivate actors also have a great influence on the territory, especially when they are large landowners. This is the case in particular for the heirs of large sugarcane companies who own agricultural land and have been able to urbanize some of their holdings: an example is Beauséjour, an eco-district developed by Cbo Territoriale (part of the Bourbon Group's real estate branch), in the mid-slopes of Sainte-Marie, as part of CINOR.

Reunion, a tropical island in the Indian Ocean, shares many

Diagram of development actors in Reunion Island



challenges with other island territories in the light of climate change: rapid and uncertain evolution of risks and climate, importance of carbon in the economic system, situation of dependence towards a few partners ... Belonging to the Indian Ocean islands community calls for reflection on island resilience and its success factors.

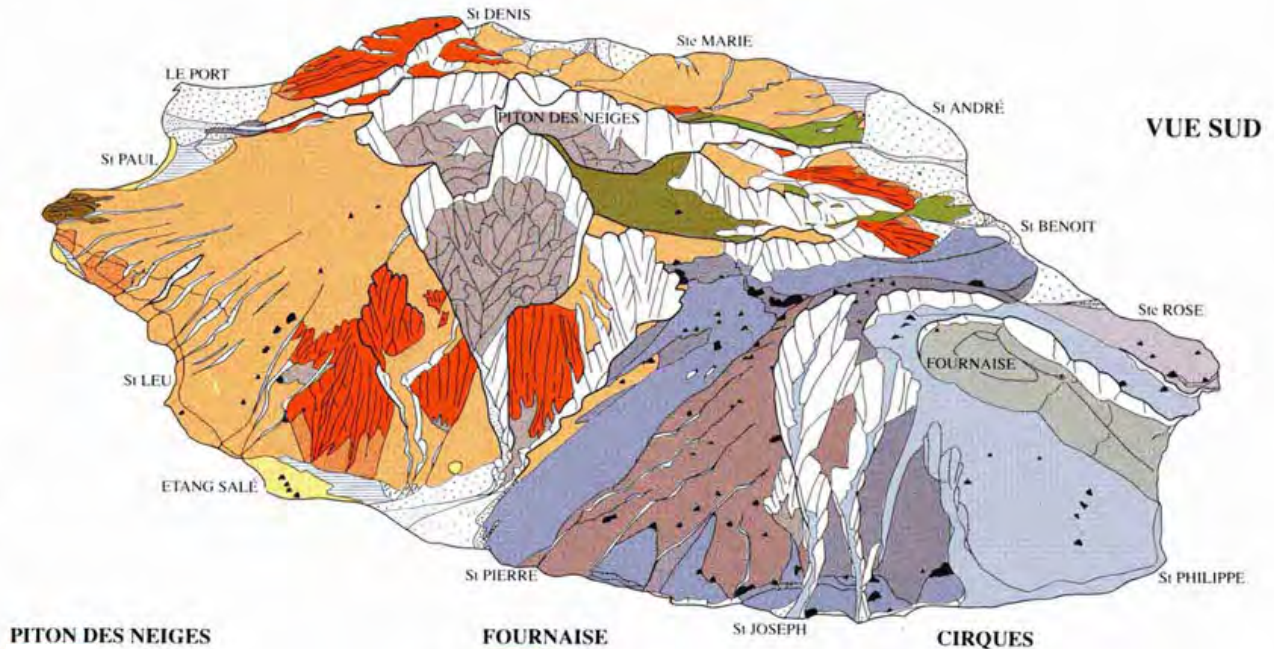
Reunion is also distinguished by its singularities. It is a multi-faceted island: its membership in France and the European Union at the same time as the Indian Ocean regional basin, gives a dual-faceted identity and status. A marked economic growth rate, greater than in metropolitan France, goes with a contrasting social situation. The solidity of institutions and policies are accompanied by a regulatory and normative complexity sometimes unsuited to local needs and a regulatory "mille-feuilles". The island is also marked by vulnerabilities, linked to its tropical environment and risks: cyclones, volcano, climate change accentuated by its topography, coastal erosion, rising sea level, flooding, mudslides... Vulnerabilities are socio-economic too : 40% of the population remaining below the poverty line, energy and economic dependence, etc.

These specificities are a call to develop specific or even experimental approaches based on the natural and human potential of Reunion Island. The diversity of landscapes and ecosystems is an opportunity to explore these relationships. Situations of isolates, sometimes excluded from contact with the outside world for weeks or even months, also allow one to project oneself into configurations of extreme resilience. Finally, as an island and tropical European territory, Reunion has geostrategic assets for the Southern Africa, East Africa and Indian Ocean region creating an environment conducive to the development of cooperation, research, development and innovation activities.



Piton de la Fournaise lava flows, auteur

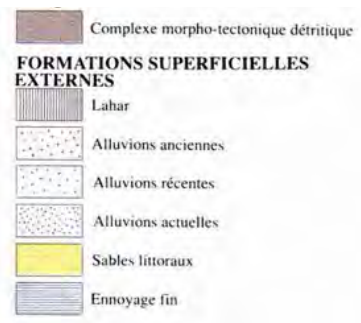
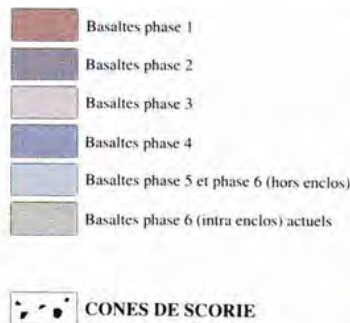
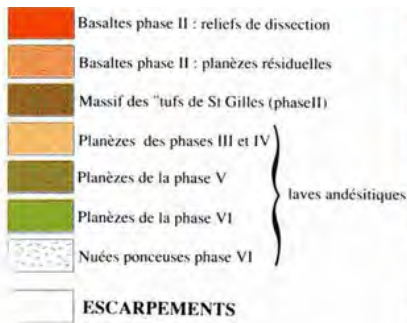
1



PITON DES NEIGES

FOURNAISE

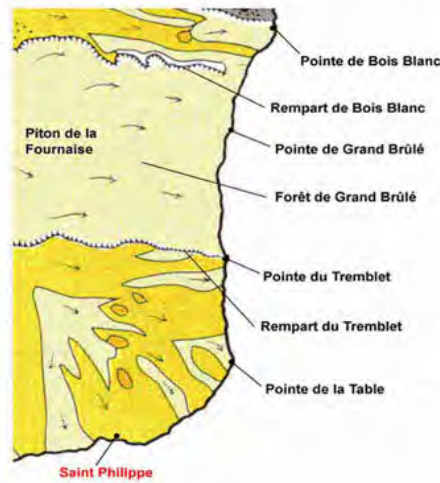
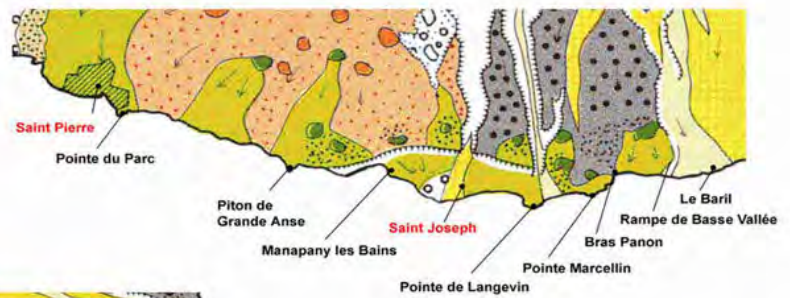
CIRQUES



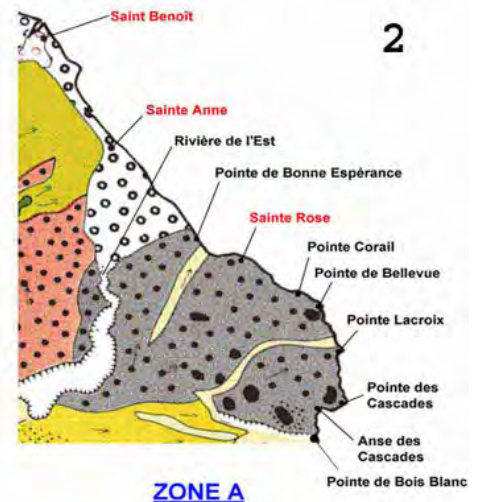
ALTES APPROXIMATIFS	TECTONIQUE	PETROGRAPHIE	PHASES
3 000 000	FLANC EST DU PITON DES NEIGES SERVANT DE SUBSTRATUM AUX EMPLEMENTS DE LA FOURNAISE ET FAVORISANT LES GLISSEMENTS ET CISAILLEMENTS EMBOITÉS (PSEUDO-CALDERAS) SUCCESSIFS DES VERSANTS ORIENTAUX		
2 100 000			
1 000 000		Océanites	1
400 000		Hawaïtes	
350 000	1ère CALDERA		
250 000		Océanites	2
220 000		Hawaïtes	
130 000	EFFONDREMENT DE LA PLANE DES PALMIÈRES RECOUVRIANT LE NORD DE LA 1ère CALDERA		
100 000		Océanites	3
40 000		Hawaïtes	
33 000	2e CALDERA ("Caldera des Sables")		
15 000	OUVERTURE VERS L'EST PRESQUE JUSQU'À 180° (DE St ANNE À St JOSEPH) DE LA CALDERA DES SABLES		
12 000		Océanites	4
10 000		Hawaïtes	
8 000	GLISSEMENT DES FLANCS EST ET SUD. PSEUDO CALDERA LIMITÉE PAR LES RAVINES BASSE-VALLEE ET CONSTANTIN.		
6 000		Océanites	5
5 000		Basaltes olivine	
0	FORMATION DE LA 3e CALDERA ("ENCLOS" GLISSEMENT DES GRANDS PENTES GRAND BRULÉ)		
		Basaltes "cotectiques"	6

SYMBOLS	DESCRIPTION
	EROSION - EFFONDREMENTS
	CIRQUES - RIV DES ROCHES - RIV DES ALPES - GRAND BASSIN - TRÉVILAVY - ENCRE DEUX
	LAHAR DE LA RIVIERE DES GALETES
	CONES DE DEJECTION "RECENTS"
	ENNOYAGES ALLUVIAUX FINS
	SABLES LITTORAUX

ZONE C



ZONE B



ZONE A

2



View of NRL from La Montagne, auteur



Cilaos, auteur

II. The challenges of insularity in the face of climate change

A. Facing the threats to ecosystems

1. Climate change : Between uncertainties and definite effects on ecosystems

Rising temperatures and water levels

Climate change is a global phenomenon that affects the entire world. However, island territories are particularly vulnerable and are considered to be some of the most revealing areas in terms of climate change effects: the omnipresence of the ocean makes the effects of climate change on natural systems more visible, and the limited size of islands underlines the importance of managing finite resources. This observation should not obscure the fact that there is a plurality of island territories, based on their size, geographical location, development model or even governance.

For more than a decade, the IPCC (Intergovernmental Panel on Climate Change) reports have indicated that island territories are “particularly vulnerable to the effects of climate change, sea level rise and extreme events”, and have even dedicated a special chapter to them²⁷. It is in particular the rise in sea level that primarily defines the vulnerability of island territories. This could reach an average of one metre by the end of the century if the average temperature rise exceeds 2°C, which seems likely today.

Climate change, which has been widely documented and scientifically established, is causing a number of effects of all kinds, the extent of which is sometimes difficult to quantify. Government departments and publications by Météo France (the French meteorological institute) and BRGM (the French Geological and Mining Research Bureau) are attempting to establish an overview of these effects, which will themselves have significant consequences for natural and human systems.

In Réunion, the rise in temperature is already noticeable and has been measured over the past 50 years. The average temperature has risen by almost one degree in half a century and this rate could accelerate by the end of the century.

The rise in atmospheric temperatures is reflected in the oceans and plays a significant role in the melting of ice packs and thereby in the rise in sea level. As this rise is not homogenous within the oceans, sea level has changed relatively little in recent decades in the Mascarene Islands (a rise of roughly 7 cm in the last 50 years has been measured in Port Louis). Furthermore, this rise differs between regions of the island due to volcanic soil movements, between a stable southeast and a northeast that is more sensitive to rising water levels. Projections for the coming years are cautious and suggest wide

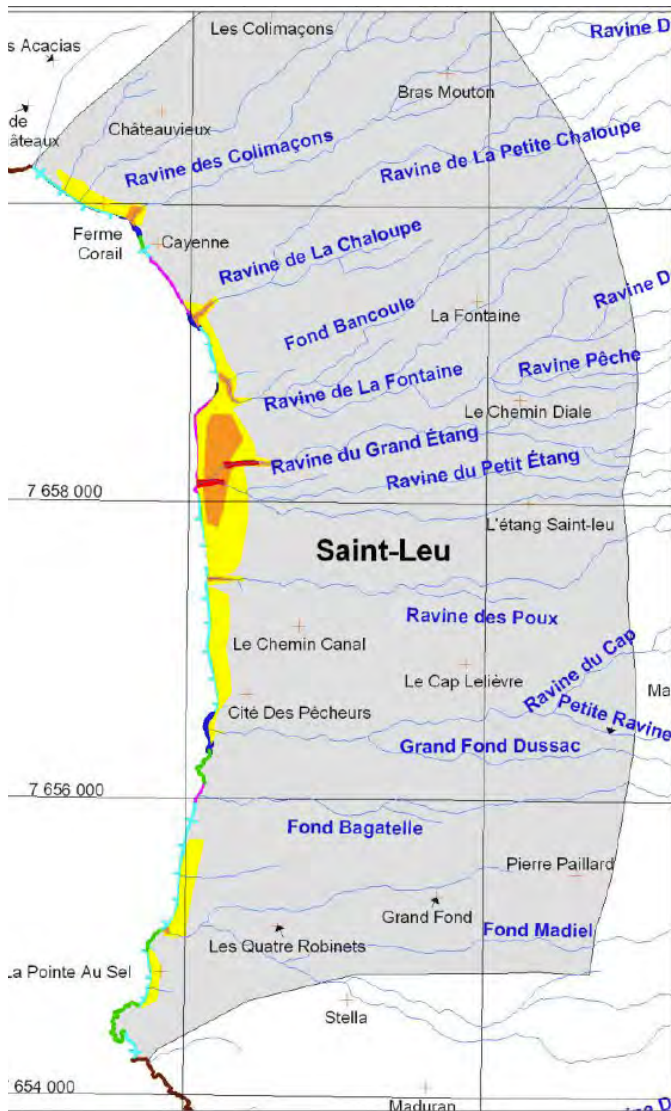
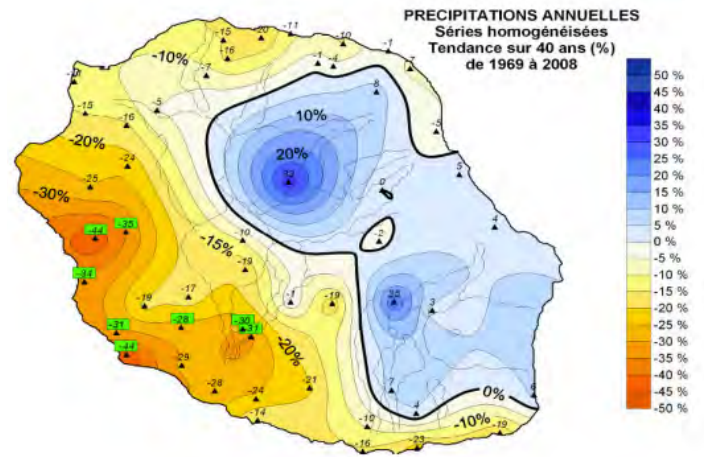
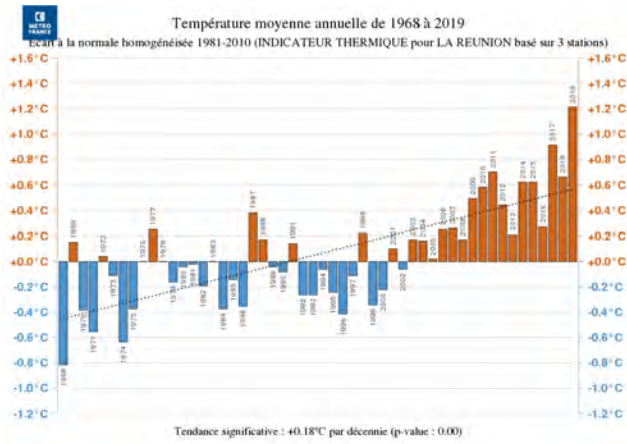
As Réunion is defined by its powerful topography, the island is at no risk of being swallowed up by the ocean. Nevertheless, certain attractive and inhabited coastal areas, which are therefore particularly vulnerable, could be affected by this rise.

The rise in atmospheric temperatures accompanied by the rise in sea level could, in the long term, make coastal areas less attractive (too hot, too dangerous) and thereby encourage the population to settle in the mid-slopes or in the Hauts, which are cooler and further away from oceanic risks.

More uneven rainfall and increased risks

Already marked by great disparities in the geographical distribution of rainfall, Réunion Island seems to be heading towards an increase in these differences. The observation of rainfall trends since 1968 by Météo France clearly denotes this dynamic. In the west and southwest of the island, rainfall decreased by an average of 35% between 1969 and 2008! This decrease is particularly noticeable during the southern winter period, between June and August, which is usually a dry period. During the same period, at the end of the 20th century, the eastern part of the island saw an insignificant increase in rainfall.

Through these various effects on the weather and the environment, climate change is leading to an increase in hazards and risks in Réunion. Observations do not currently indicate more frequent cyclone activity, but cyclone episodes are likely to become more intense and devastating. Increased heavy rainfall could lead to landslides or flooding, and is expected to contribute to erosion. The rise in sea levels coupled with swells and cyclones could also lead to periods of coastal submer-
sion²⁸.



Above :

Evolution of average temperatures from 1968 to 2019, meteo france

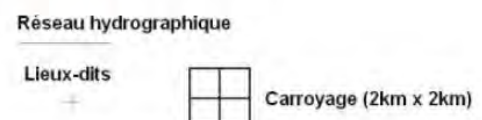
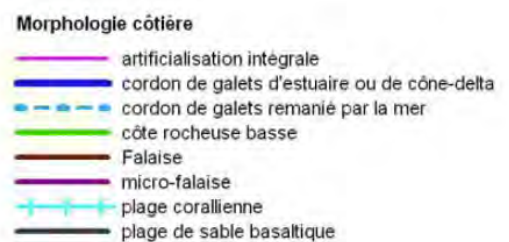
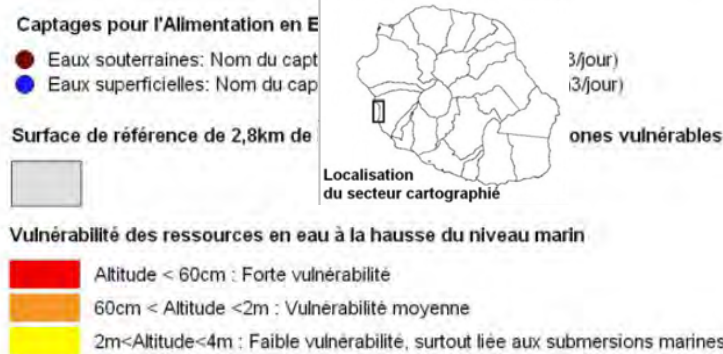
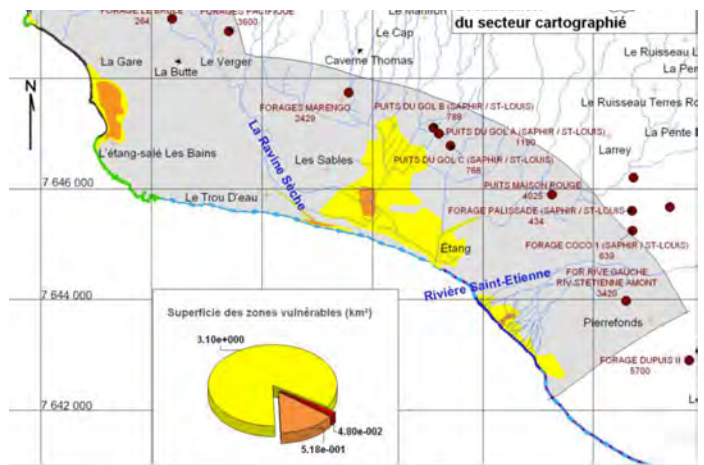
Evolution of annual precipitation between 1968 and 2006, Météo-France

Opposite:

Mapping of areas of vulnerability to sea level rise and submersion, Etang-Salé, Etang du Gol, Pierrefonds, BRGM 2011

Below :

Mapping of areas of vulnerability to sea level rise and submersion, Saint-Leu, 2011



II. The challenges of insularity in the face of climate change

A. Facing the threats to ecosystems

2. Réunion's exceptional land and biodiversity in danger

A fragile island endemism

Biodiversity refers to the variety of living species within an environment. This notion was popularized when it was perceived that this diversity was threatened by human activities and could upset the natural balance. It has become a focus of attention on a global scale since 1992 following the Earth Summit in Rio de Janeiro.

Island biodiversity has its own specificities and a pronounced vulnerability.²⁹ The conditions of isolation, specific to the history of the islands, have favoured the development of organisms specific to these environments: endemism (the presence of species found nowhere else) is high. Endemism is to be distinguished from indigenism, which applies to species that have developed without the action of man (but which can eventually be found elsewhere). Endemism is particularly strong in the Mascarene Islands. These island environments, unique in their own right, are particularly vulnerable as their original balance was already rapidly disrupted by the arrival of new occupants such as humans. An example and symbol of the threat that humans can represent for endemic species is that of the dodo, a large bird encountered in Mauritius at the end of the 16th century. The dodo had no predators on the island, but the arrival of humans and other species brought by boat (dogs, cats, macaques, etc.) led to its extinction in less than a century.

As far as Réunion is concerned, the botanist Thérésien Cadet revealed the extraordinary biodiversity present on the island, particularly in the Hauts, in the 1970s.³⁰ Nevertheless, it is threatened. The French committee of the International Union for Conservation of Nature (IUCN) regularly publishes a "red list" of threatened species in France. The picture painted of the island is quite alarming: "more than a third of Réunion's bird species are threatened or are now extinct. The three terrestrial reptiles are threatened, as well as 14% of the butterflies, 21% of the dragonflies and damselflies and 33% of the island's freshwater fish". The flora is not to be outdone either; of the 905 native fern and flowering plant species present on the island, "49 have become extinct and 275 others are now threatened". Furthermore, a total of 237 plant species are found nowhere else but on Réunion Island, 82 of which are threatened (35%).

These species see their survival balance being upset by man or by other species, and a snowball effect thus follows: plant or animal extinctions often lead to others. After the Bourbon tortoise in the 19th century, it is now

the Bourbon green gecko that is threatened with extinction, a victim of the degradation and fragmentation of its habitat. The Petit Tamarin des Hauts, a small tree found near the volcano, is suffering the consequences of urban and agricultural developments, notably grazing and fires. The Red Palmetto stick insect, discovered in 2000, depends on the Red Palmetto to feed and lay its eggs. But this palm is being illegally felled and is becoming increasingly rare: the stick insect is now critically endangered.

In addition to direct human disturbances, the island's species suffer from strong competition from introduced species which occupy the land and degrade the natural environment, i.e. "invasive alien species". For several years now, Réunion has been experiencing an upsurge in these invasive species. Introduced voluntarily or involuntarily by man, these species then spread spontaneously, finding suitable living conditions in Réunion, and develop in an exuberant way, causing a negative impact on the species originally present. This is today the main cause of the loss of biodiversity on the island. This phenomenon mainly concerns plant species but is also found in the animal world. The Etang du Gol, a marshy area on the edge of the ocean in the commune of Saint-Louis, becomes entirely covered with water lettuce and water hyacinth at certain times. During these periodic episodes, the plants suffocate the lake and lead to the death of numerous fish.



Little Tamazin from the Hauts, Parc National de La Réunion

How to protect Réunion's biodiversity and endemism by bringing together all the island's stakeholders ?

The Réunion National Park is the main tool set up to combat the threats to biodiversity. The first discussions to create a park began in 1985. In 1995, the first Regional Development Plan underlined the need to preserve the island's green heart. In 2000, the General Council and the Regional Council asked the State to create a national park, which would be the tool for the island's protection. The park was finally created in 2007, under the supervision of the Ministry of Ecology. It is now one of the 11 French national parks.

The Réunion National Park has two main zones. The "heart of the park" (105,400 hectares, i.e. 42% of the island) is the sanctuary zone and is currently subject to special regulations: works, constructions and installations are prohibited in principle. A charter describes the park's main missions and actions in this zone (preservation of landscapes and biodiversity, promotion of the culture and potential of the Hauts, etc.). Within this mainly natural core area, there are also small areas where human activities occur: the "inhabited core" (the Mafate cirque, with its 800 inhabitants) and the "cultivated core", for livestock farming, forestry, geraniums, etc. The "heart of the park" corresponds to the area listed by UNESCO as "Pitons, cirques and remparts" in 2010.

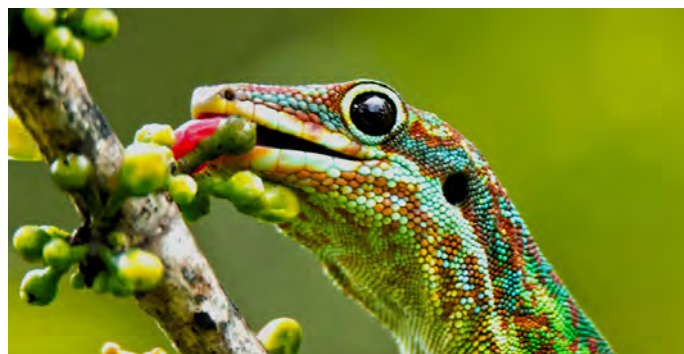
Around the "heart of the Park" is the "membership area" (87,800 hectares, 35% of the island), which covers the rest of the Hauts and the main ravines. This area is not covered by the park's regulations, but the island's communes are invited to enter into partnerships with the park for the balanced development of this zone. Of the 24 communes, 19 chose to join in January 2021.

Nonetheless, the park's actions are not sufficient to deal with the issue of invasive species, which are proliferating across the entire island. The Direction de l'Équipement, de l'Aménagement et du Logement (a decentralized service of the State) therefore developed a "Strategy for the Fight against Invasive Species in Réunion" in 2010, in collaboration with the Region, the Department, the National Park and the National Forestry Office. This strategy aims to prevent the introduction of new invasive species, to carry out rapid eradication or control actions for species in the process of being established, to raise public awareness and to create a system of governance capable of coordinating the various stakeholders in the area. The "Réunion Biodiversity Strategy", launched by the State, the Region and the Department in 2013, is based on this same broad partnership.

Citizen action is also essential for success in controlling invasive plant populations. Associations such as the Société Réunionnaise pour la Préservation de l'Environnement have been invited to carry out participatory awareness-raising campaigns, notably through the Citizen's Plan for the Control of Exotic Species, which was financed by the EU.



Schematic plan of Réunion National Park, Roger Brunet



The Bourbon green gecko above sees its existence threatened by the Madagascar gecko, which steals its habitat and food, Stéphane Michel



Dam installed on the Gol pond to prevent the proliferation of water lettuce, pôle tropical

II. The challenges of insularity in the face of climate change

A. Facing the threats to ecosystems

3. In the ocean, coral is affected by both climate change and human activities

Coral reefs: Fragile ecosystems

Coral reefs border approximately one sixth of the world's coastline. They are home to exceptional biodiversity and play a crucial role in food security for millions of people. However, reefs are under severe threat from human activities and environmental disturbances associated with global climate change.

Réunion is no exception to this trend. The young island has part of its coastline lined with coral reefs. Its youth is the reason for the small surface area occupied by the coral formations, which are only 8,000 years old. These formations delimit shallow lagoons, the largest of which is no more than 500 m wide and roughly 1 to 2 m deep. These lagoons form a discontinuous reef belt 25 km long (i.e. 12% of the island's coastline) and constitute a total surface area of 12 km², all located on the west and southwest coast of the island. Although this surface area is quite small, it is a richly diverse environment, hosting over 3,500 animal and plant species.

Nevertheless, an imbalance in the functioning of these reefs can be observed. The colours are fading, algae are proliferating, and there are fewer parrot fish to clean the algae. Biodiversity is declining overall: almost a third of these species were already considered threatened or vulnerable in 2009. Fifteen percent of coral species are threatened or near-threatened.

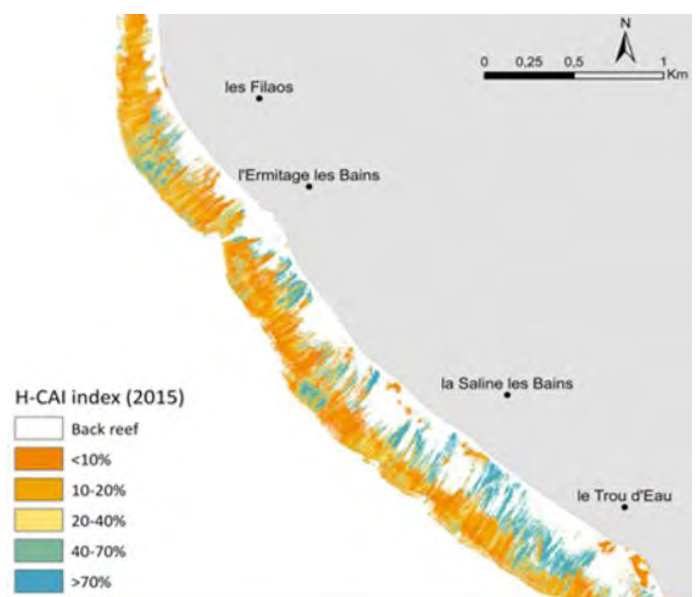
Climate change, and in particular warmer waters, is one of the reasons for these extinctions, since it causes coral bleaching. Heavy use of the reef and the impact of the adjacent watershed are also having a dramatic impact on the reefs, particularly near the coast. The lagoons are subject to numerous uses, including sports and leisure as well as fishing activities, which can directly affect animal and plant life. Less direct but devastating nonetheless are the pollution inputs from agricultural and domestic activities, which come from run-off and soil and mud flows, encouraged by inland deforestation and urbanization. Lastly, the work on the New Coastal Road is also generating fears for certain corals and bottlenose dolphins, which have their habitat in this area, despite the 147 mitigation and compensation measures that represent 5% of the road's budget.

How to take collective care of marine biodiversity ?

Created in 2007, the Natural Maritime Reserve of Réunion was set up to curb this degradation. The reserve covers 3,500 hectares along a forty-kilometre stretch of coastline and borders five communes. It therefore pro-



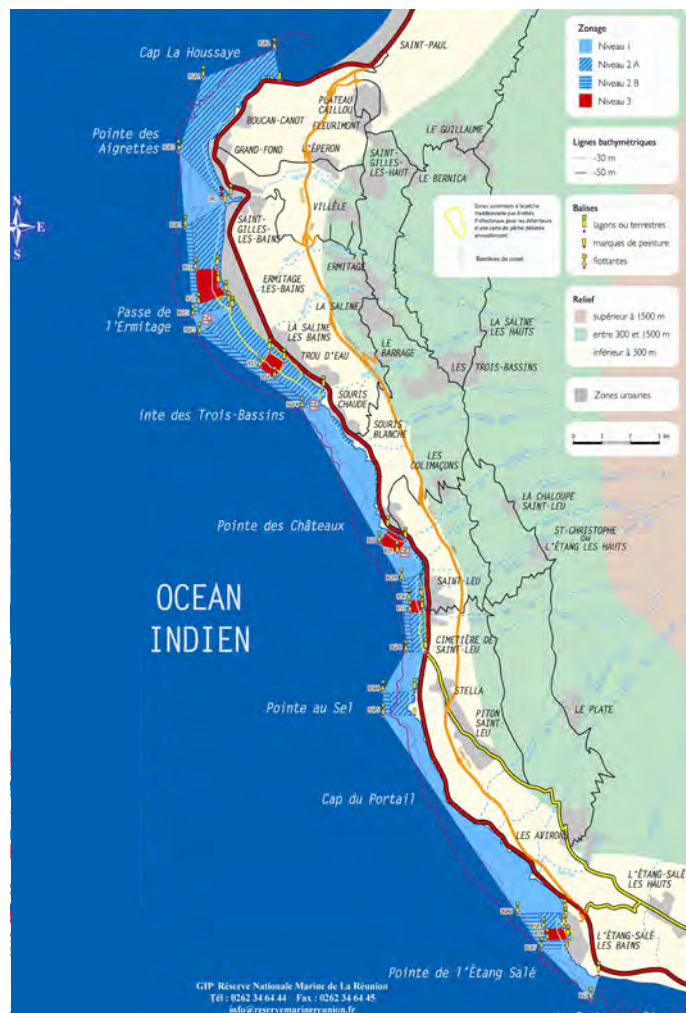
Lagoon biodiversity, Phillippe Bourjon



Assessment of the evolution of coral health in Saint-Gilles between 2009 and 2015 by hyperspectral technology

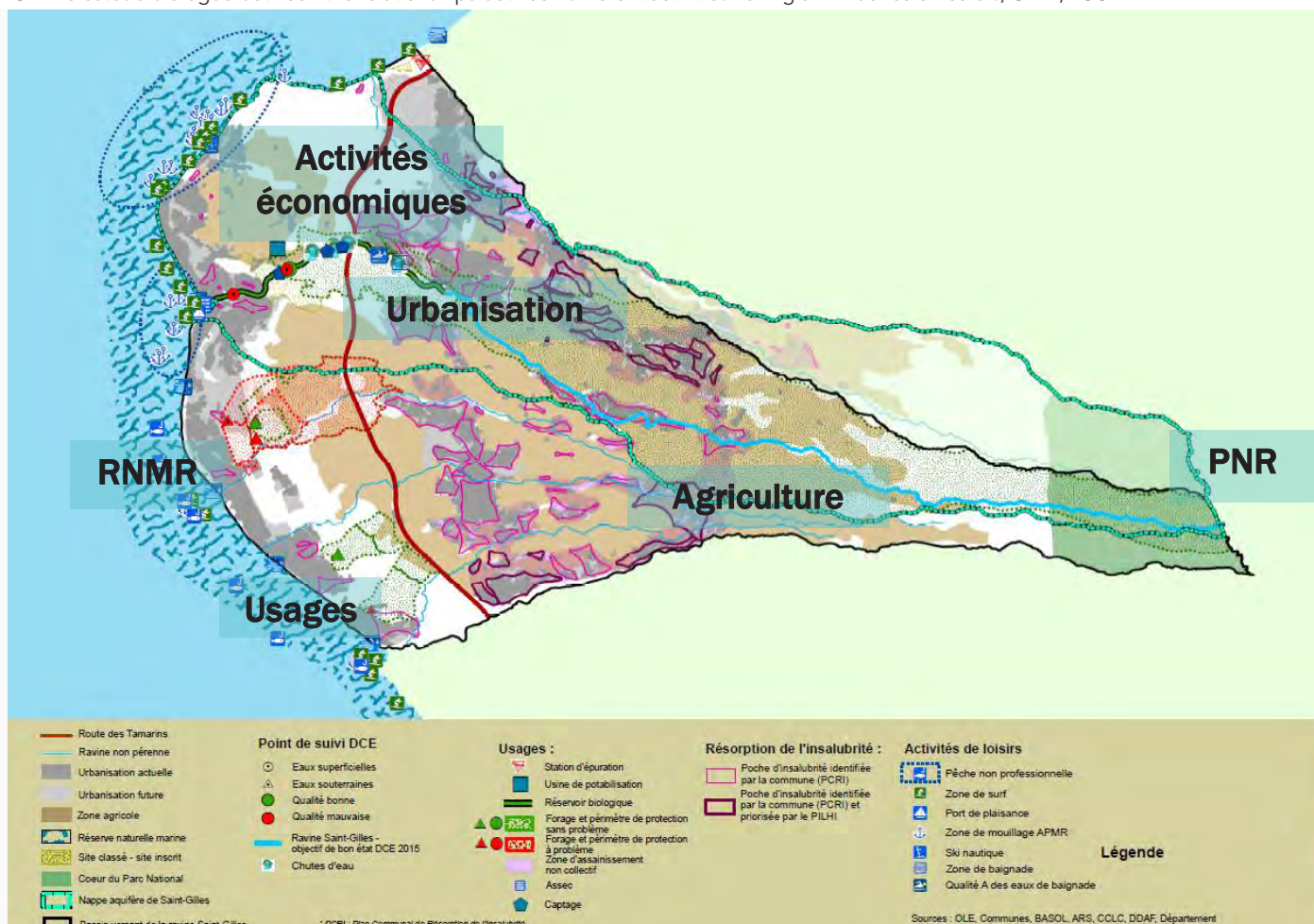
fects 80% of the island's coral reefs. The area is divided between the general perimeter, the reinforced protection zones (45% of the surface area) and the integral protection zones (5%). Water sports are regulated in these areas, and in the case of the integral protection zones, all human activity is prohibited to allow for a more rapid repopulation of the coral reefs. The rules and delimitations are indicated by signs on the beaches.

Nevertheless, this approach, which is necessary to limit the degradation of aquatic environments, does not prevent pollution from watersheds. The "Integrated Management of the Environment and Coastal Areas", tested in 2013 by TCO (as detailed in the Round Table 1 Synthesis), has made it possible to bring the various stakeholders to the table in order to adopt a collective management approach. Collective management that considers the "land-sea continuum" is necessary to limit the negative effects of these complex phenomena.



Extent of the Réunion Marine Reserve

GIML creates a dialogue between the relationships between different activities having an influence on corals, GIML, TCO



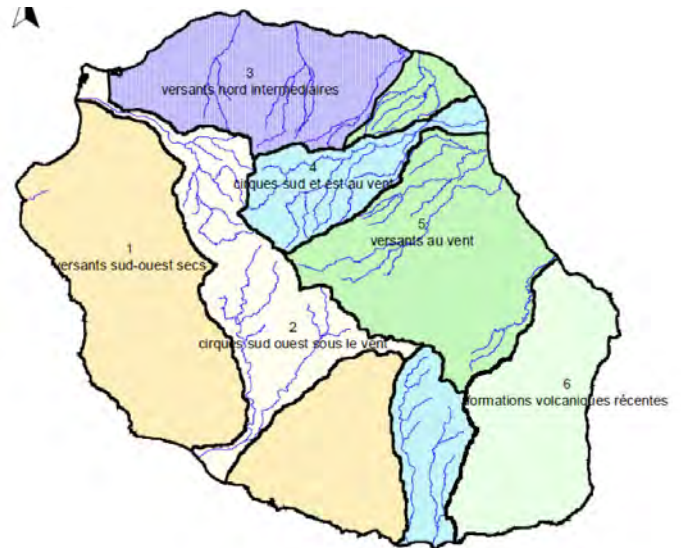
II. The challenges of insularity in the face of climate change

A. Facing the threats to ecosystems

4. Ensuring the sustainability and quality of water resources

Tons of water, pouring down and then dissipating

Réunion Island is spectacularly endowed with fresh water: holding several world records for rainfall, it receives between 3 and 5 billion cubic metres of rain each year. However, rain is not easy to store and use. This water often pours down in short, violent episodes and is unevenly distributed over the territory. Moreover, the island's relief causes water to slide down the steep slopes of its watershed: Réunion's volcanoes have risen due to successive inflows, which have also formed vast regular slopes (inclinations between 5° and 18° towards the sea) called *planèzes*. During heavy rainfall, water flows into the ravines within these *planèzes* in an irregular manner and thereby forms torrents. Réunion also has 13 perennial rivers, fed by the island's large recesses: the cirques and the large valleys that drain the water from the Piton des Neiges and Piton de la Fournaise massifs. Water also comes from several springs and sometimes continues its way under more recent volcanic flows, before reemerging in the form of waterfalls that dot the heights of the island³¹.

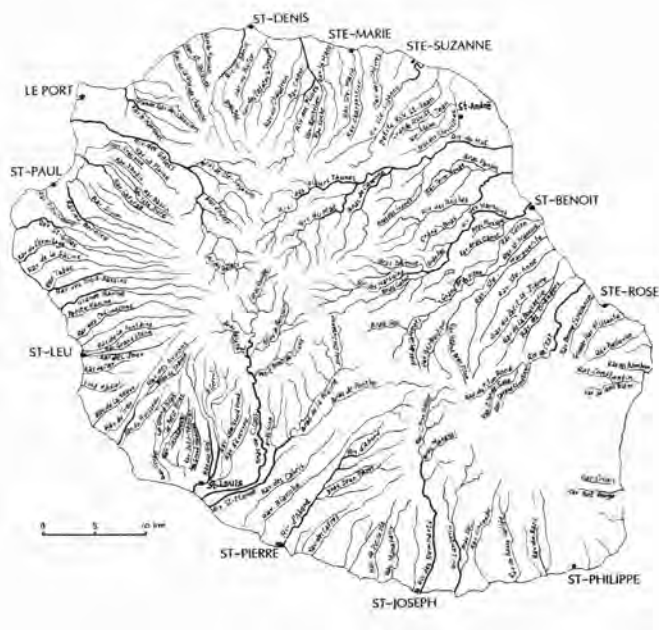


Hydro-eco regions, SDAGE 2016

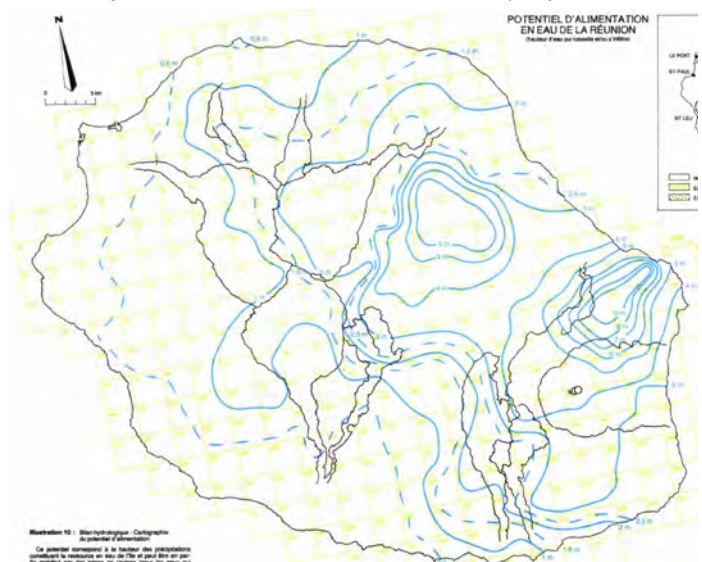
The transfer of water from east to west

This fresh water, distributed unevenly over the territory, has been collected and transferred by canals and aqueducts for irrigation and domestic use since the settlement of man on the island. Water networks have developed all along the coast. However, these works are subject to climatic hazards, which can destroy their infrastructure or lead to clay in the water, making the latter unfit for consumption: the water supply is not completely reliable.

In the 1980s, a remarkable set of works was launched under the name of the West Coast Irrigation Project, nicknamed the "shifting of the waters". Completed in 2014, after 25 years of work, this infrastructure project consists

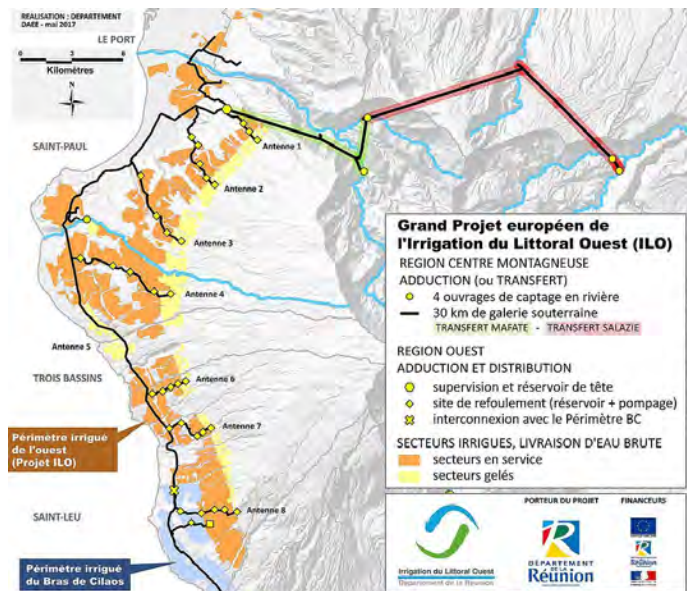


Hydrographic network, Raunet 1991



Water supply potential, BRGM

of a major network of pipes transferring water from the eastern massif of the Piton des Neiges to the west. An underground aqueduct crosses the cirques of Salazie and Mafate and irrigates the entire west coast. This infrastructure is intended to provide drinking water, but also, and above all, to allow for the development of agricultural activity on the western mid-slopes up to an altitude of 660 metres. The project was financed by the European Union, the State and the Department of Réunion.



Irrigation works on the west coast, Oriunga Kessel

Quality and management of distributed water

Today, the quality of tap water is variable. Only 50% of subscribers are supplied by correctly equipped networks (purified groundwater or filtered and purified surface water). For the rest, 46% of inhabitants are supplied by networks that do not guarantee sanitary safety (lack of purification), and for 4% of Réunion's inhabitants, the sanitary risk is proven. This is the case in particular for the area of the Hauts, which has insufficient infrastructure. In many places, particularly in the east, it is still not advisable to drink tap water after heavy rain. Indeed, 58% of

the population drinks water taken from the surface of rivers, which are transformed into torrents of mud during heavy rainfall. There is therefore still a significant need for investment.

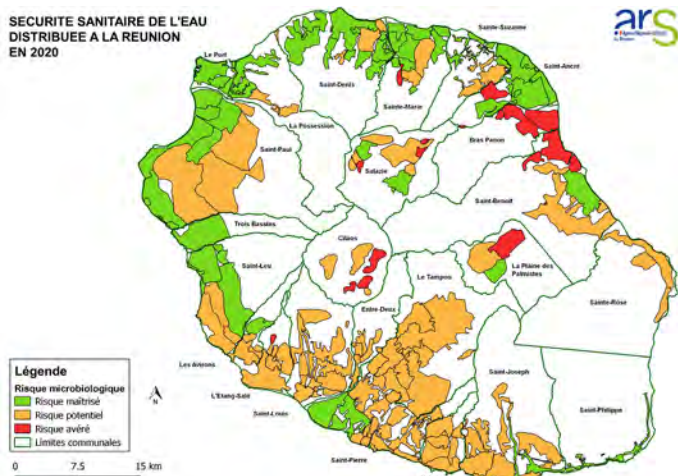
Water management in Réunion concerns a number of stakeholders:

The Basin Committee (a sort of "local water parliament" bringing together the State, local authorities, users and experts) decides and directs water policy in Réunion through the Schéma Directeur d'Aménagement et Gestion de l'Eau (the current Schéma concerns the period of 2016-2021).

The Water Office, a public institution attached to the Department, provides financial aid for works and expertise in the field of water.

The inter-municipalities have been responsible for water and collective or non-collective sanitation services since 1 January 2020.

The State: the Prefect of Réunion coordinates the actions of State services which are responsible for water policing and the application of the main principles defined by Europe and France.



Quality of water distributed in 2020 according to the Health and National Agency



Cascade Lanvegin

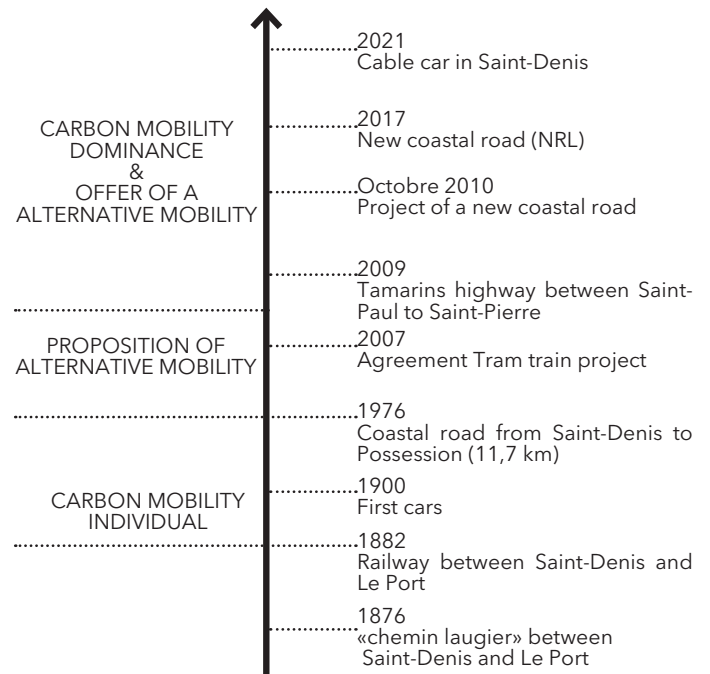
II. The challenges of insularity in the face of climate change

B. Respecting the limits of a finite territory

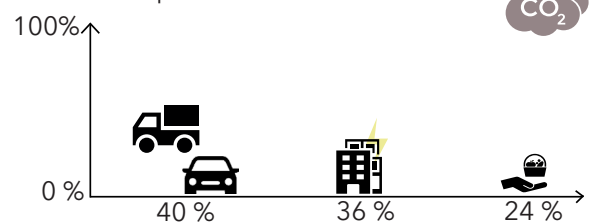
5. La Réunion is subject to heavy congestion and carbon-based mobility

The temptation of asphalt to which Réunion has succumbed can be seen in its highly anthropic territory. Urban sprawl is contributing to the expansion of motorized travel, the increase in distances travelled and travel speeds. The possibility of living further away, with more attractive land prices, and of working outside one's own catchment area disrupts the morphology of cities, reducing the amount of agricultural land as well as increasing the amount of impermeable surfaces and carbon-based mobility. Today, 48% of carbon emissions are linked to transport in Réunion³²: mainly individual and by car (66%), with public transport being highly inefficient (7%) and soft mobility representing only 25% of overall mobility. Commuting (four daily peaks have been noted in the area) leads to unavoidable daily traffic jams at the entrances and exits of towns. In fact, working people who travel by car, public transport or two-wheelers cover an average of 25.3 km each day for their home-work journey.

"One might expect the space of this mobile and limitless world to be open, smooth and unfettered. In reality, contemporary urbanity is marked by the global success of the separation principle."³³



Carbon footprint of La Reunion in 2012



The island's peripheral urban network is linked by major road infrastructure such as the Tamarinds Road or the National Road. This urban and coastal ring forms a whole network of mobilities, paradoxically creating powerful breaks in the territory due to the island's topography (the relief of the Hauts) and hydrography (the ocean, the ravines and the rivers), which constrain its course since it inserted between the ocean and the mountains. Continuity of use is interrupted and large programmatic enclaves are produced, forcibly separating human activities to either side of the ring, on an increasingly sterile soil.

The choice of the "all-car" is a challenge in the face of climate change. How can the desire for mobility be met while remaining energy- and carbon-efficient?



A few initiatives

There are many projects that aim to make up for the “all-car” preference.

In order to take into account the development of the Hauts, to improve its transport network and to free up the roads, the CINOR is developing several urban cable car lines. The first urban cable car line will link the Chaudron, Moufia and Bois-de-Nèfles sectors. This alternative to car travel will serve the upper and mid-slope areas. A 2.7-km project, with a completion date scheduled for the end of 2021, it is intended to improve the public transport network. A second line is planned. It will be 1.3 km long and will link Bellepierre/La Montagne. Currently, the district is only accessible via the RD41. The second line will provide a permanent alternative and reconnect the district of La Montagne to the rest of the city. It is planned for the end of 2023.

Run Rail is the new public transport service of the regional guided transport network. It will eventually link Saint-Benoît to Saint-Pierre via the north and west. The section linking Saint-Denis and Sainte-Marie is planned for 2024. This 150-km project, supported by the region, is evolving. To start with, the construction of public transport infrastructure (TCSP) in the short to medium term in each catchment area will provide an immediate response. Secondly, the Regional Guided Transport Network will offer direct transport between each urban centre and be connected to the urban networks of the Mobility Organizing Authorities (AOM). This network, designed as the backbone of the island’s public transport system, has a key role to play in the coordination and structuring of the territory.

In parallel, the TAO (Tram Aéroport Entrée Ouest) project, supported by the CINOR, would link the western entrance to Saint-Denis and the Sainte-Marie airport. Public debate on the TAO ended in 2019. The 13-km-long line is scheduled to be operational by 2023.

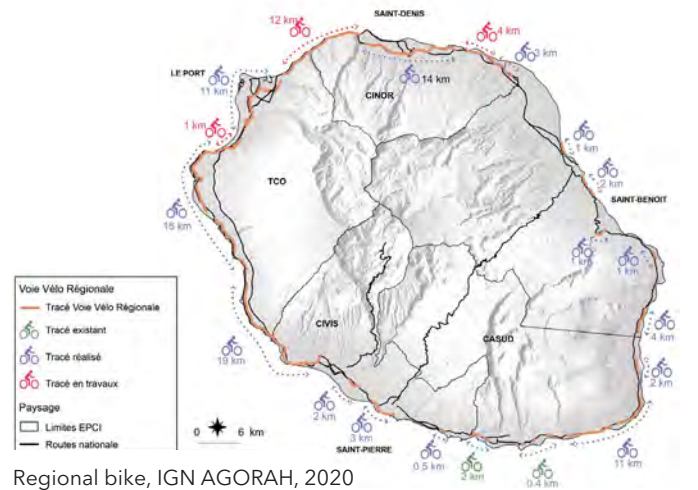
However, in recent years, car-sharing has also been gradually developing. This change in behaviour on the part of motorists is motivated by financial gain, conviviality and a contribution to sustainable mobility. This is why, spontaneously, parking areas are emerging around road interchanges. The region has therefore seized this opportunity to progressively formalize the development of carpooling stations.

The Réunion Region adopted a regional cycling plan in October 2014. It consists of 222 km, 51% of which was completed by 1 January 2021. Cycling represents only 1% of the modal share.

All of this aside, the preference for the “all-car” mode is still prevalent on the island, e.g. the New Coastal Road (NRL) project. Road infrastructure continues to produce a hard, discontinuous environment. This new road, intended to relieve congestion on the national highway, shifts the problem of dependence on individual carbon-based mobility onto a new infrastructure.



Image and plan of the cable car, telepherique-urbain.cinor.re



Regional bike, IGN AGORAH, 2020



Runrail, habiter-la-reunion.re



New coastal road, habiter la réunion

II. The challenges of insularity in the face of climate change

B. Respecting the limits of a finite territory

6. The carbon-intensive and externally dependent construction sector

Réunion Island imports its building materials. This dependence on the outside world has many consequences. Economically, this results in the increased cost of imported materials (35%)³⁴. Thus, due to the higher construction costs, the choice of materials is constrained to those of lesser quality, which then also limits the evolution and transformation of buildings.

The materials imported into Réunion also have environmental consequences. Most of the imported materials are petroleum-based. They are referred to as conventional materials because of their high carbon impact, as opposed to local materials, which may be petroleum-based but have a lower carbon footprint insofar as they are produced locally and do not undergo the same energy-intensive transformation processes that emit greenhouse gases. Moreover, current construction practices (construction methods, choice of materials, building life) are a source of harm to the immediate environment and to the territory. Housing is also an accentuating factor in the energy dependency of Réunion as it accounts for almost 22% of the territory's energy consumption, and more than 45% of its electricity consumption (103.3 ktoe out of a total of 228.5 ktoe)³⁵. The standards required in metropolitan France in terms of hydrodynamics and acoustics for new buildings are unsuitable for overseas territories, which are characterized by a humid tropical climate. This is why regulations in the DROMs have a different standard and are provided with specific financial aid. The DOM Thermal, Acoustic and Ventilation Regulation (RTAA DOM) takes into account the specific climatic features of these territories. The 2016 RTAA DOM was designed to reduce the energy consumption of new buildings for residential use in overseas territories and to maintain the comfort of the occupants. The RTAA DOM is based on the principles of natural ventilation, solar protection and solar energy.

This dependence on imported materials also has social consequences. In a context of accelerating demographic growth (a 28% increase in the population between 2013

and 2050)³⁶, high demand for new buildings and renovations will result in even greater pressure on the land. This imbalance between supply and demand creates questions of over-occupation.

All these consequences lead to a disconnect between construction and the expectations of the people of Réunion in terms of sustainability and heritage preservation. Thermal comfort is a particular question on the island due to the territory's climatic zoning, and affordable ready-made solutions are often not compatible.

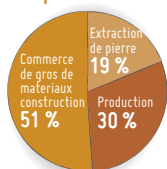
Nevertheless, Réunion Island has developed a recognized savoir-faire and expertise in terms of construction in tropical settings. The state of this sector in Réunion shows a market made up of a limited number of players, mainly small-scale and not necessarily export-oriented. However, the entire value chain is present, from design to construction, as well as suppliers of bio-based materials.

Simple and sustainably sourced architecture integrated into its environment, i.e. meeting the climatic needs and uses of the people of Réunion?

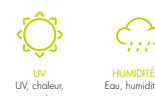
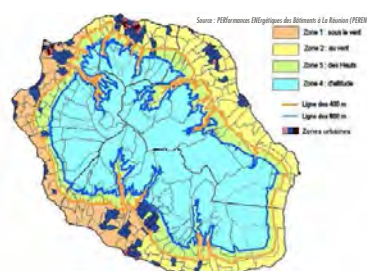
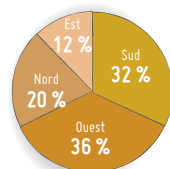
Designing a bioclimatic building means designing a building that is adapted to its surroundings in order to make the most of them, with a view to saving energy and optimizing comfort. The difficulty in tropical areas, and more particularly in Réunion, is climatic zoning. The implementation of bioclimatic building principles aims to facilitate the achievement of thermal comfort in a passive manner (without consuming energy or emitting greenhouse gases) by integrating the natural features of the chosen construction site.

To meet the energy challenge, many projects have emerged. The ANR ORASOL and ADEME RAFSOL research programmes have provided some solutions: integrated solar air conditioning with an optimization of solar cooling processes (2006/2010) and the implementation of an absorption-based solar cooling system (2008).

Nombre d'entreprises par activité



Répartition géographique



In terms of energy-efficient air conditioning, the SWAC 15 (Sea Water Air Conditioning) project is a project that utilizes seawater for cooling needs. Located in Saint-Pierre, this project aims to substantially reduce electricity consumption by 90%, i.e. 10 GWh per year, the equivalent of the consumption for a town of 6,000 inhabitants. It is financed by the European Regional Development Fund (ERDF) and the ADEME.

EDF's 100% solar micro-grid project aims to experiment with energy storage. Located in Mafate, it is based on a lithium battery system that allows for short-term storage (48 hours maximum) of non-consumed solar energy and a hydrogen chain that allows for up to a week's response to demand. Since 2017, three public buildings have been equipped with this system: a school, a dispensary and the premises of the ONF. Co-financed by EDF, the Syndicat intercommunal d'électricité de la Réunion (Sidélec) and ADEME, homes are to be the next to be connected to this micro-grid.

Sustainably sourced architecture is a key to Réunion's independence in the field of construction. Moreover, the use of local materials appears to be a catalyst for employment and enhances the value of non-localizable know-how.

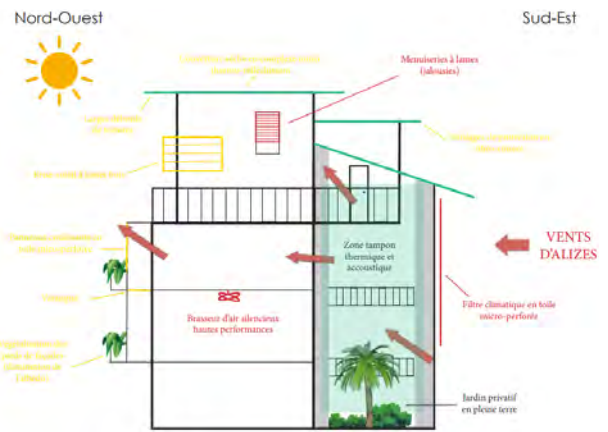
For example, Réunion's cryptomeria is recognized as a structural wood for buildings. This conifer, introduced to the island at the end of the 19th century, was adopted in the 1950s as a reforestation species because of its ability to adapt to volcanic soils, mountain climates and cyclonic winds.

The reuse of maritime containers for housing is another example of the reuse of materials already present on the island, even if they are imported.

The BioRev/Tropics project – promoting the use of local materials for construction in the tropics – identifies potentials in terms of local materials and the sector. The programme is supported and financed by the DIECCTE (Direction des Entreprises, de la Concurrence, de la Consommation, du Travail et de l'Emploi de La Réunion).

The evolution of the regulatory context and the development of technologies as well as the quality of construction are reflected in the local explosion of projects demonstrating Réunion's know-how, such as the development of virtuous buildings. The prototype for a single-family house, the Démété case, is made without cement and adapted to the climate of Réunion Island thanks to its cross-ventilation architecture and natural air-conditioning. The DÉMÉTÉ case is equipped with photovoltaic panels as well as rainwater and grey water recovery systems. The project was carried out in partnership with the General Council and the developer CBo Territoria.

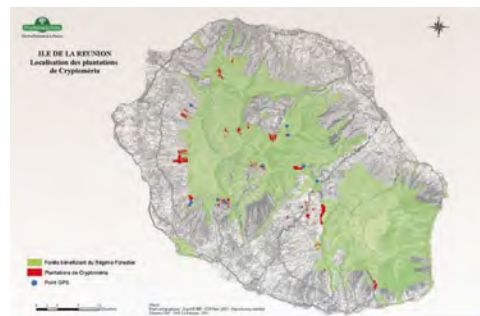
EnviroBat Réunion (an observatory for the sustainable tropical built environment in Réunion) offers nearly sixty project reports, drawn up by professionals, which enable users to share their experiences of buildings constructed in Réunion.



Principles of tropical building, EnvironBAT-Réunion, 2014



Micro-grids, SWAC project, maritime container project, le livret vert du bâti tropical, 2018



Cryptomeria, ONF



Démété case, le livret vert du bâti tropical, 2018



Classification of the 27 local resources selected as part of the Biorev/Tropics project

II. The challenges of insularity in the face of climate change

B. Respecting the limits of a finite territory

7. Réunion: An island saturated with waste

On average, each person in Réunion produces 634 kg of waste per year (DMA)³⁷. Given this situation, the challenges surrounding waste in Réunion are constantly growing, particularly due to the increase in the island's population and economic activity, but also due to the need to preserve the environment.

This waste comes from local communities, households, economic activities, agriculture and forestry, construction and public works. Between landfills and the exporting of trash to Asia, there are very few dedicated channels for waste. Nevertheless, there are 16 EPR (Extended Producer Responsibility) structures in charge of collecting and transforming waste, ranging from the recycling of pleasure boats to household packaging and medicines.

Household and related waste (DMA) is waste collected by the public waste management service and whose producer is not a household.

Residual household waste (OMR) accounts for the majority of the waste flows produced, representing 44%. In fact, on the island, after use, most refuse is buried without any form of recovery. That said, 40% of waste is organic matter from gardens (25%) or food scraps (15%). Nevertheless, 70% of waste is unfortunately buried while only 30% is recycled.³⁸

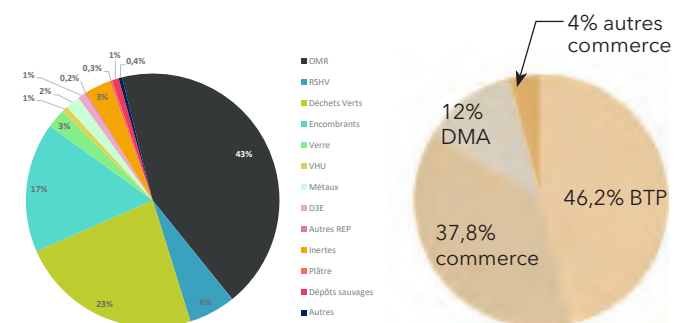
The island's landfill sites will reach full capacity by 2021 and 2022. One of the sites is located in the commune of Saint-Pierre, at Rivière Saint-Etienne. Operated by the CIVIS since 1987, this 30-hectare site collects waste from Le Port to Saint-Joseph. The other site is in Sainte-Suzanne and collects waste from the northeast sector. In order to meet the challenge of waste recovery, a multi-stream centre has been created in Sainte-Suzanne. The waste of Réunion's inhabitants and companies in the north and east is recycled in a recycling facility in order to create a circular economy. Another centre is being considered in Pierrefonds, supported by the TCO, CIVIS and CASUD. The RUN'EVA project is scheduled for 2023.

In addition to household waste, construction-related activities generate large volumes of waste, particularly due to the high renewal rate of imported materials, which are generally of poor quality. The construction waste deposit amounted to 2,384,072 tonnes in 2017. Reducing the volume of waste produced and not recycled on the island is a major challenge.

What means should be put in place for a respectful waste recycling and recovery system on the island?



Study scope of the Reunion waste observatory, 2018



DMA collected in tonnes, Reunion Island Waste Observatory, 2019

Waste by sector, Source Espélia, 2015



Waste life cycle, Observatoire réunionnais des déchets



Mapping of waste sorting, treatment and recovery equipment, Ademe



Landfill site de Pierrefonds

The island's insularity and the saturation of its landfill sites make waste recovery a necessity. In this context, the President of the Regional Council expressed the desire in 2018 to commit the island to a proactive "zero waste" programme, in addition to complying with national and European obligations. Projects for the recovery of waste and the creation of new channels are emerging in many sectors.

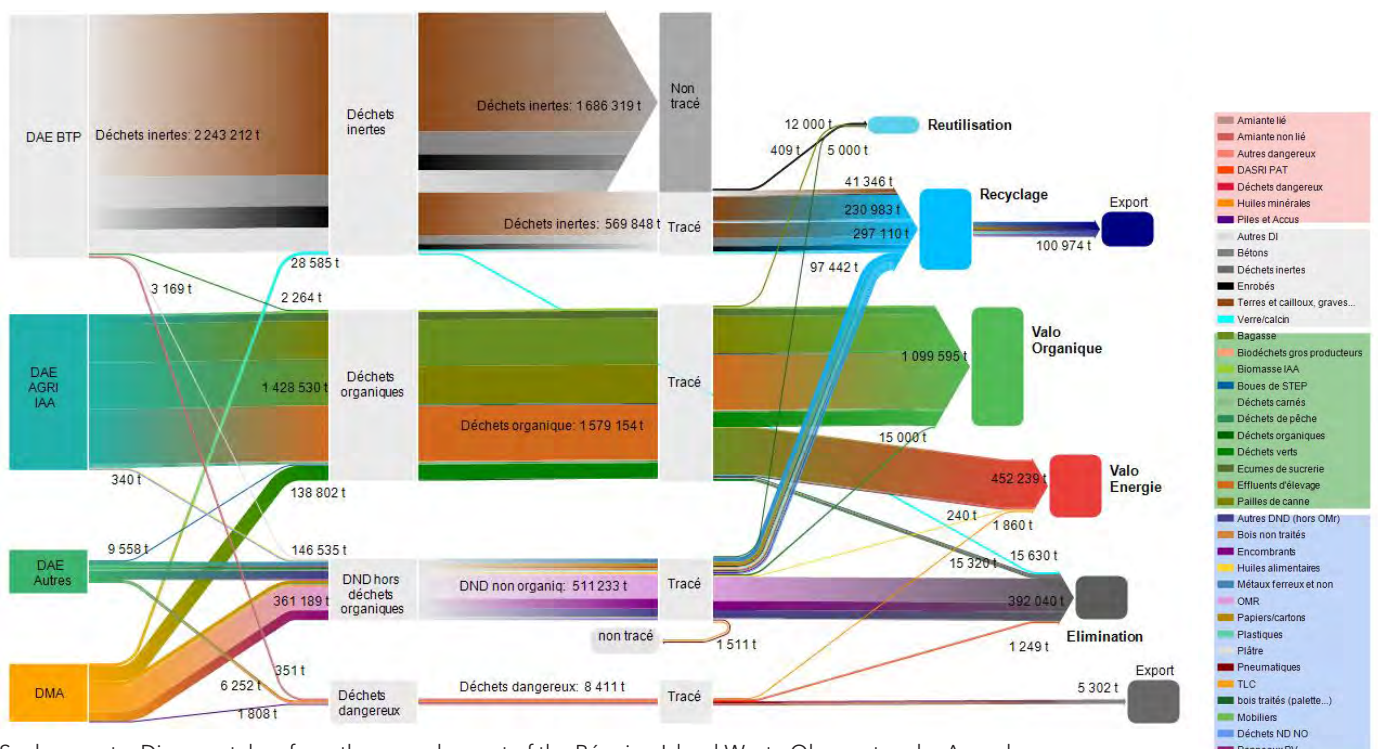
For example, a number of projects around compost are developing, and include both collective and individual composting. One such project is the Alchimistes Péi, which is working on the launch of a local bio-waste management system in Réunion and the Indian Ocean Region. As part of a circular economy logic, the ambition of the Alchimistes Péi and its network is to promote, facilitate and encourage the practice of local composting.

On a larger scale, there are numerous biomass sources found on the island, including bagasse, fodder, green waste, livestock manure and food waste. A bio-economy is being developed through the use of biomass, for

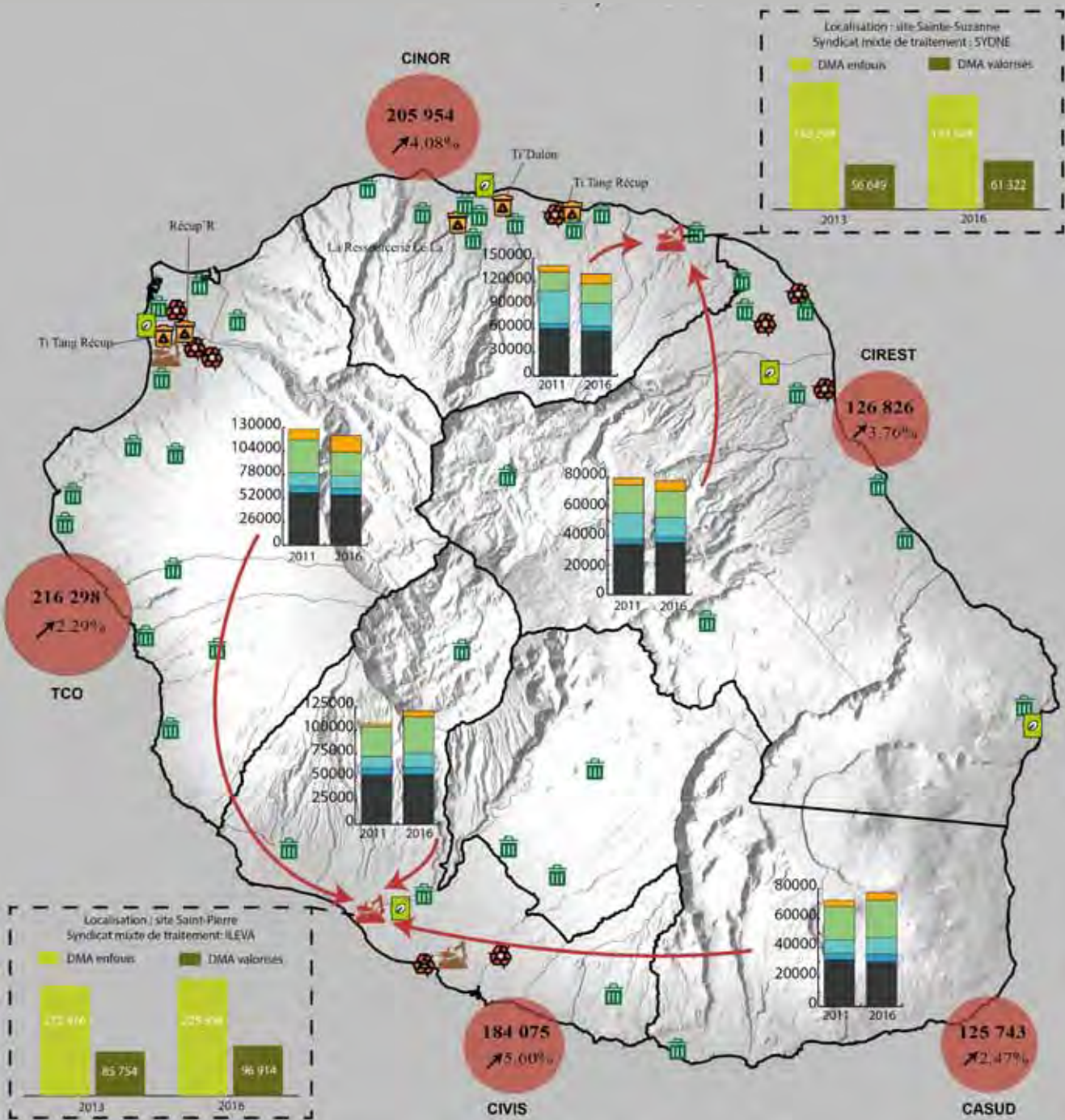
example through the GABiR project (Gestion Agricole des Biomasses à l'échelle de la Réunion), which is supported by CIRAD. In addition to the recovery of this waste form, biomass sources are used to produce energy. For example, bagasse is the residue of sugar cane produced by crushing the cane once the juice has been extracted. With almost 1,900,000 tonnes of cane produced each year, 537,000 tonnes of bagasse are fed into Réunion's two thermal power stations.

In the construction sector, the circular economy is essential. This is why the construction sector is mobilizing. For example, the BioRev/Tropics project places a strong emphasis on materials from recycled waste.

Faced with the imminent saturation of landfill sites, the territory has several options such as waste-to-energy incineration or the energy valorization of solid recovery fuels. However, this option has been strongly criticized as a polluting and expensive solution. Waste management in Réunion therefore remains a major challenge.



CHIFFRES CLÉS DES DÉCHETS MÉNAGERS ET ASSIMILÉS À LA RÉUNION, EN 2016



Contexte général

Traitement des déchets

Déchets Ménagers et Assimilés

- Déchèteries
- Ressourceries
- Centres de tri
- ISDND
- ISDI
- Plateforme de broyage et de compostage

- Ordures Menageres Résiduelles
- Emballages Ménagers Recyclables
- Encombrants
- Déchets verts
- Autres

Flux de déchets vers les ISDND

0 7.5 km
Sources : AGORAH | IGN

II. The challenges of insularity in the face of climate change

B. Respecting the limits of a finite territory

8. The evolution of Creole public spaces

The historical context combined with political, economic and social circumstances has influenced the urban spatial organization of Réunion, as much in terms of the urban framework as for the structuring of the urban space, where two models intermingle and follow one after the other.

The first, the historical one, is a legacy of the colonial plantation system and also of the island's climate.

The structure of the old town reflects in its broad outlines the socio-spatial organization of sugar plantations, with their factories and houses. Moreover, as a tropical island, Réunion has developed a way of life based on the outdoors. The Réunionese enjoy being outside whether for traditional picnics on the beach or fishing for *bichiques*. They also integrate botanical diversity into the Creole home. The custom of the "kour" and the "kaze" garden illustrate this way of life. As such, urban public spaces initially only served the function of passage or mobility. Due to the heat, these spaces are not suitable for resting or strolling.

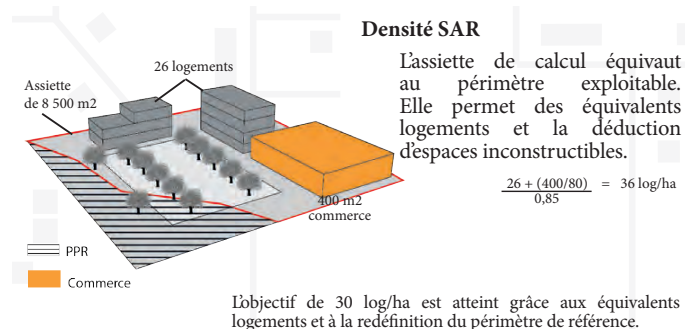
The second model is the result of the social and economic evolution following the departmentalization of the island and is closer to the French urban model. The creation of numerous dwellings since departmentalization to today has transformed the ways of living on the island. The boundary between the private sphere and the public space is shifting. Typically, the space of the kour or kaze garden is open to the outside world and linked to the life of the neighbourhood. However, the sociability of the family space is evolving and urban public spaces are emerging. *Public space refers to all spaces intended for use by all. It brings together all spaces where people circulate or gather.* Public space thus becomes an essential component in the structural organization of a city. It can take several forms: a green space or a space

for strolling, resting, meeting and socializing. It is a sort of extension of the kaze garden, representing the traditional way of life turned towards the outside. At the same time, the public space is also becoming a public media space where the dissemination of information and the formation of public opinion are developing.

The features of the colonial city, with its narrow streets and large residential plots with gardens, make land use difficult. The historical grid is often in opposition to the principles of development, which favour density due to land scarcity. For urban renewal and measured densification, the SAR imposes minimum densities on all new urban projects (varying from 20 dwellings/ha to 50 dwellings/ha)³⁹. The implementation of the SAR's requirements is carried out through operational tools such as the PLU, the concerted development zone (ZAC) and a voluntary land action programme. In addition, development policies integrate the following objectives: diversified public spaces, the promotion of soft mobility, the integration of nature in the tropical city, urban forms integrated into the landscape, diversity of typologies, good living and well-being, and local service offers. This is why associating density with urban form makes it possible to offer a quality of life that combines quality of use, landscape and user comfort.

Despite these principles and regulations, the challenges of urban spaces are still present. For example, in terms of sports facilities and policies, the island differs from the logic and patterns known in metropolitan France. From a desert of sports facilities in 1949, the island now hosts diversified but unequally accessible sports facilities.

What means should be implemented to ensure the quality of urban space while respecting the Creole way of life?



Cathedral Square in Saint-Denis, CAUE et DEAL de la Réunion, livret de la densité et qualité urbaine

The Beauséjour project in Sainte-Marie is a development project carried out by CBo Territoria and authorized by the commune. Located near Saint-Denis, road infrastructure and employment areas, Beauséjour is a new town of more than 8,000 inhabitants across 78 hectares. The works are numerous and varied. This is why particular attention is paid to public spaces and the diversity of activities. Les Bambous, a semi-collective development, offers 73 homes per hectare. The project management team has taken particular care to propose private and public spaces that are integrated into the landscape according to the topography. The Bois de Joli Cœur complex is a collective housing project (101 dwellings per hectare). With its green and open centre, the project management team has created a place of exchange where social interaction is encouraged.



Beauséjour : density 70houses/ha, Sainte-Marie
MOA : CBO Territoria
Beauséjour biodiversity reserve, Jacques Rival

The Ravine Blanche neighbourhood, situated in the continuity of Saint-Pierre, was isolated and mono-functional. Thanks to the urban renovation project carried out by the city, this neighbourhood is now linked to the historic district and offers inhabitants new public spaces, to which particular attention was paid. They have been redesigned and new facilities have been integrated to meet the needs of the inhabitants. A 2-hectare urban park installed in the heart of the district allows for the restoration of an ecological continuity, the management of rainwater, and the provision of breathable and relaxing spaces, necessary for the densification of the district.

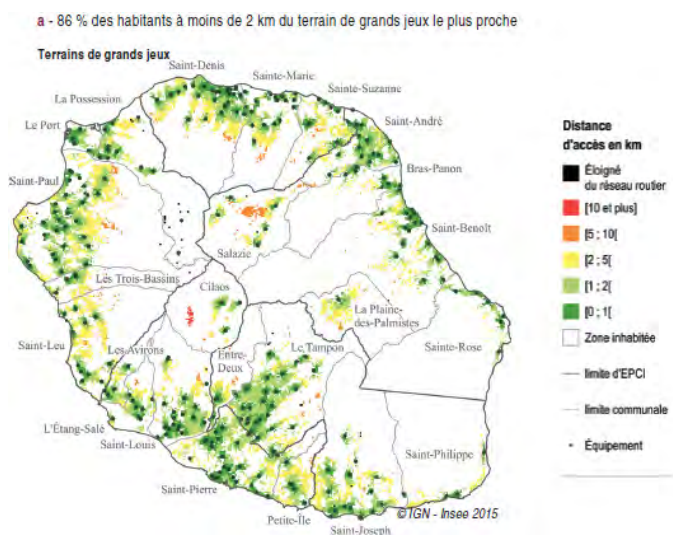


Ravine Blanche : density 50houses/ha, Sainte-Pierre
Public spaces requalified with an urban park of 2ha,
Source : Aymeric Delmas, Doctorant CIFRE IMAGEEN / Laboratoires PIMENT et CRENAU

Other developments, such as Les Capucines in Saint-Louis, emphasize the importance given to public spaces. This project is located near the centre of Les Makes, a high-altitude rural village in the commune of Saint-Louis. The project management team created pedestrian walkways on this plot of land which consists solely of individual houses. These wide, shared green spaces open out to the ocean and serve as a medium for exchanges and meetings.



Les Capucines : density 47houses/ha, Sainte-Louis, Les Makes
Pedestrian alleys animate an open and common space.
MOA : Sogedis / MOE: Néo Architectes



Sportive course in Le Port, CAUE et DEAL de la Réunion, livret de la densité et qualité urbaine

II. The challenges of insularity in the face of climate change

C. Reducing economic and island vulnerability

Small island economies are often characterized by a degree of external dependence, due to the weight of tourism and certain imports, which are often carbon-based (energy, food, etc.). This situation leads to a certain fragility in the face of external shocks, as the pandemic crisis has reminded us. Réunion is not exempt from this dependence, although awareness of this interdependence is increasing.

1. Food security in La Réunion

Between land competition and imports

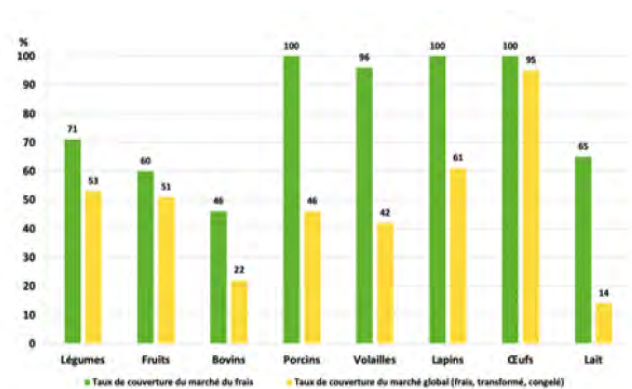
Of the 252,000 ha of land on Réunion Island, cultivated land represents 42,000 ha, a figure that has been stable for several decades (representing 22% of the territory, with the Réunion National Park accounting for 41% and built-up land and urban areas being 12%). The island's agriculture, although constrained by the terrain, seems to pursue a dual objective: the export of sugar cane products and food self-sufficiency. Sugar cane covers 54% of the utilized agricultural area (22,700 ha). In addition to its historical character, it is a crop adapted to the environment: its powerful root system allows it to be anchored and therefore more resistant to cyclones and drought. This advantage is all the more important given that nearly 40% of Réunion's agricultural land is threatened by landslides or flooding⁴⁰.

Fruit and vegetable production can be found throughout the territory (12,500 ha or 30% of the agricultural land, of which more than 5,000 ha are privately owned), and particularly marks the landscapes of the east and south. Livestock farming (12,750 ha) is found mainly in the Hauts. These activities only partially feed the local market. In 2019, Réunion's agricultural sectors covered 72% of the fresh produce market and 42% of the overall market (fresh, processed and frozen)⁴¹. The animal production sectors were however able to cover almost all of the island's needs in terms of fresh products for pork, poultry, rabbits and eggs (almost 100%). Réunion's seafood market relies mainly on imports (91%). Réunion imports fish and prawns, even if the export of high-value-added toothfish and lobsters brings the trade balance into equilibrium.

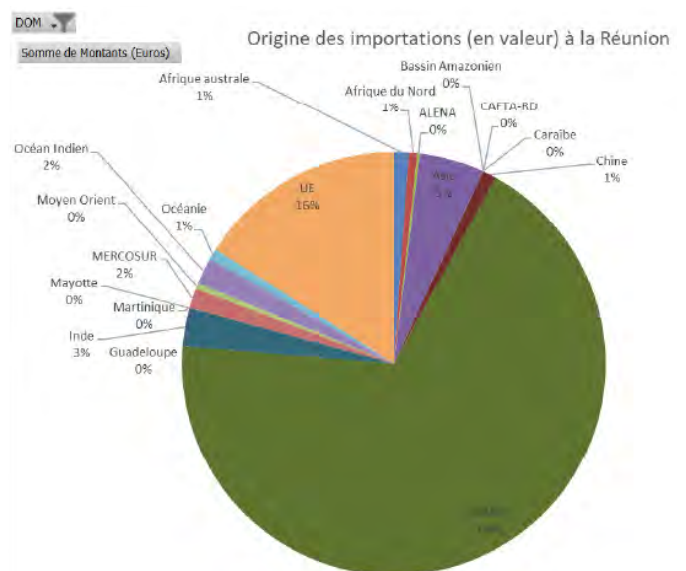
The health crisis and the closure of borders showed the importance of the issue of food self-sufficiency, highlighting in particular the dependence on imports of onions and garlic, which were out of stock for many months. It also highlighted the sector's responsiveness in organizing itself to meet the challenges of distributing products to the local population, including people in financial difficulty (distribution of solidarity baskets).

Projects aimed at promoting diversified and local agriculture seem to bring together institutions and a part of the population. The Department, through its Ecological and Solidarity Transition Plan, encourages diversification and pursues the objective of reaching an 80% share of

locally produced fruit and vegetables by 2030. It also encourages organic farming, which is still a small sector (3.5% of the agricultural area) but one that is growing rapidly. Civil society is not to be outdone, notably with ambitions to develop local rice cultivation (the most massively imported product). The academic community, and in particular CIRAD, is supporting the movement by promoting the labelling of high value-added "Pei products".



Coverage rate of the fresh and global market by Reunion's agricultural sectors, Agreste Reunion 2019



Origin of value imports in Reunion Island, CIRAD



Alley in the heart of the sugar cane plantation in La Possession



Rice growing in the Jardin de Paulo with the Riz Réunion association, Imaz Press Reunion



Cultivation of PAPAM (Aromatic Perfume and Medicinal Plants) in the Dioré forest, Saint-André (CIREST), zinfos974



Pepper cultivation at the Saint-Paul pond, TCO

Changes in eating habits

Réunion's food model is linked to its multicultural history and migrations. Originally composed of products grown around homes, imported rice replaced corn and became synonymous with the "Creole meal". The meal then consisted of a single dish, with rice systematically accompanied by a cooked dish (meat, fish in sauce, or even a vegetarian preparation), legumes (grains) and condiments (*rougail*, spices). From the 1990s onwards, the diet became richer in animal proteins, sugar and fat. This era saw the spread of supermarkets and mass consumption, with the addition of starters and desserts, sweetened drinks and starchy foods to meals, as well as new practices around fast food restaurants (pizzas, hamburgers, sandwiches, etc.)⁴².



Picnic area by the ocean, Imaz Press Reunion



New Burger Kings open regularly, here the one in Saint-Gilles, Burger King



Tuna cari, chef Papounet

II. The challenges of insularity in the face of climate change

C. Reducing economic and island vulnerability

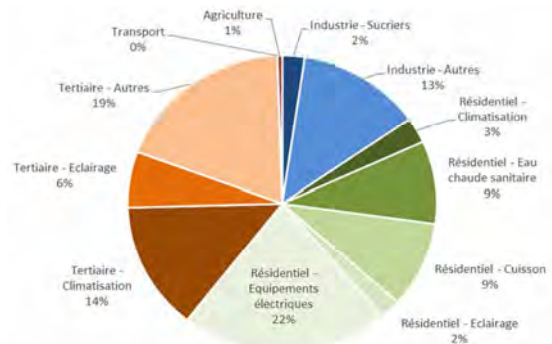
2. A slower than expected energy transition

Due to its island status, Réunion is a Non-Interconnected Zone (ZNI), i.e. not connected to the continental electricity grid. This isolated territory has to produce all the electricity it consumes with imported fossil fuels (38% coal and 30% fuel oil), supplemented by local renewable energies. Under this regime of a carbon-based and petroleum-dependent economy, accentuated by the massive increase in the population and the import of lifestyles based on fossil fuels, Réunion's energy dependency reached 87% in 2017. In 1982, its energy dependency was 41.6%. In 2017, Réunion's electricity production mix reached 256.7 ktoe, 32% of which was renewable, compared with 18% in mainland France. Its primary energy consumption amounted to 1,460.7 ktoe, with 13% coming from local resources. The climatic and geographical characteristics (rugged terrain and remoteness) as well as the small size of its electricity system create major constraints for the energy mix, the management of the electricity network and the supply. As a result, electricity supply costs are higher than in mainland France. In 2017, the island's electricity consumption was 2,746 GWh, with a domestic consumption of 1.44 MWh/year per inhabitant.

The 2015 Energy Transition for Green Growth Act set a target of energy autonomy for overseas collectivities by 2030. In 2015, Réunion Island had an installed capacity of 463 MW of renewable energy resources, half of which was made up of photovoltaic systems, a third of which was hydroelectricity, and the rest of which was mainly biomass (bagasse).

ADEME provides technical and financial support to local authorities to draw up and implement their territorial Climate Air Energy Plan (PCAET). The PCAET is a strategic and operational sustainable development project for a given territory. In Réunion, one such plan has already been implemented: that of the Communauté intercommunale du Nord de La Réunion (CINOR). It covers 24% of the island's population. Two others have been launched by the Communauté intercommunale Réunion Est (CIREST) and by the Communauté intercommunale des Villes solidaires (CIVIS).

What form of decarbonized energy autonomy?



Reconstitution of electricity demand by sector and use in 2015, OER, EDF, SEI, 2015

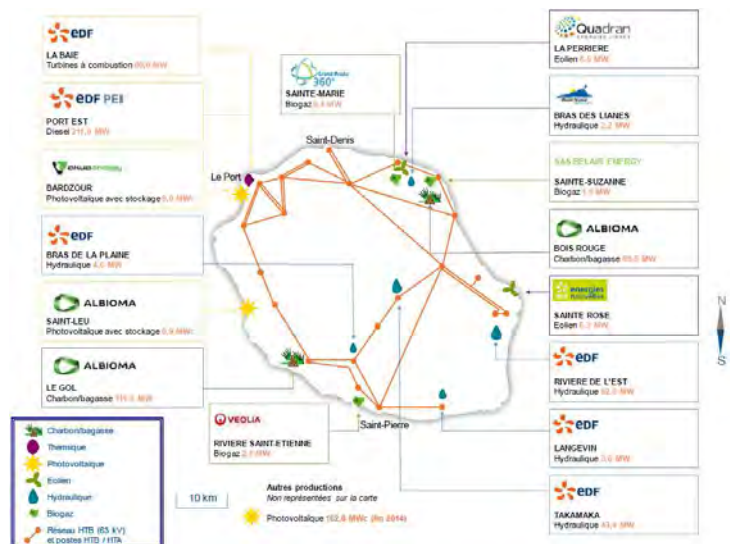
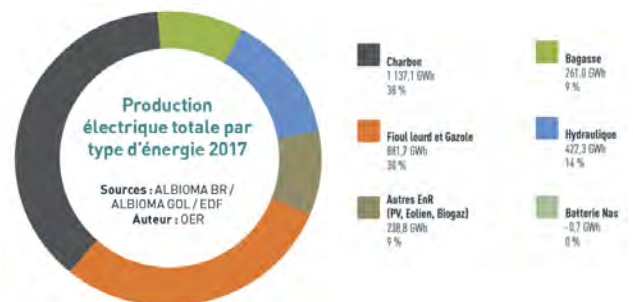
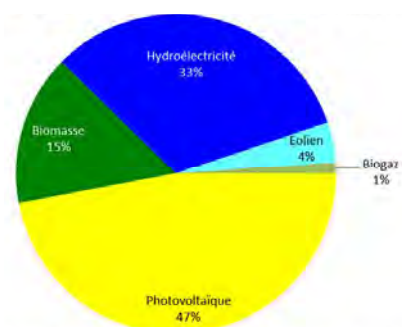


Diagram of Reunion's electricity network, EDF, SEI, 2015



0,46GW - Breakdown of renewable energy installed by sector in 2015, ADEME, Artelia

The island has the necessary resources for a renewable energy mix. The existing capacity plus the additional potential provides a total capacity potential (available in 2030) of 1.9 GW, excluding imports.⁴³

The photovoltaic sector is expanding rapidly in Réunion and constitutes an important resource.

This sector is characterized by its geographically diffuse nature and its variability over time. It competes with other land uses such as solar thermal energy for rooftop installations and other land uses for other installations. By 2030, intermittent PV capacity is expected to be 310 MW. The potential future of photovoltaics in a constrained grid context would involve accompanying it with a means of storage.

Legend: residential roof, mid-sized roof (collective, tertiary), large-scale roof, car park, ground.

Photovoltaic project: Akuo Indian Ocean is developing renewable energy in Réunion, Mayotte, Mauritius, Madagascar and the Seychelles.

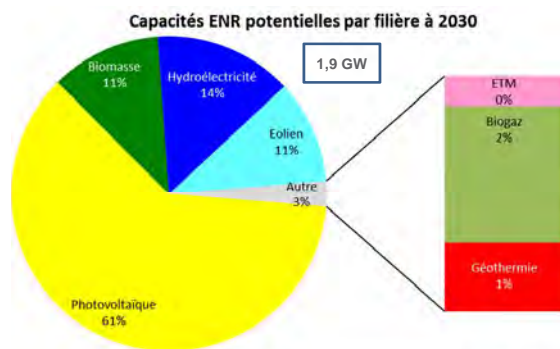
The wind energy sector in Réunion is constrained by the cyclonic context and therefore by the additional cost of installations despite the significant potential along the coastline. In 2015, Réunion's wind farms had a cumulative capacity of 16.5 MW. The Schéma Régional Eolien (SRE), finalized in 2015, provides a new estimate, based on a more detailed analysis, of 78 MW of favourable potential and identifies some additional small areas of installation.

The hydroelectric resource is subdivided into two main categories: natural waterways and utility networks (drinking water/irrigation/wastewater).

River resources have historically been the main source of electricity production on the island, used to supply small local electricity networks. In 2015, the installed hydroelectric capacity in Réunion was a nominal 136 MW, with 3 power plants of significant capacity: Takamaka I and II, and Rivière de l'Est. It has changed little compared to other renewable energies over the last 15 years. The hydroelectric sector has to face environmental constraints linked to the obligation to increase the reserved water levels of the rivers hosting their operations. A project to upgrade the existing Takamaka power station, Takamaka III, was studied and scheduled for 2023, but it has now been halted.

The biomass sector includes all biodegradable elements of living organisms. All organic matter of plant (including algae), animal or fungal origin can become a source of energy by direct combustion or after methanization or gasification (which is under development).

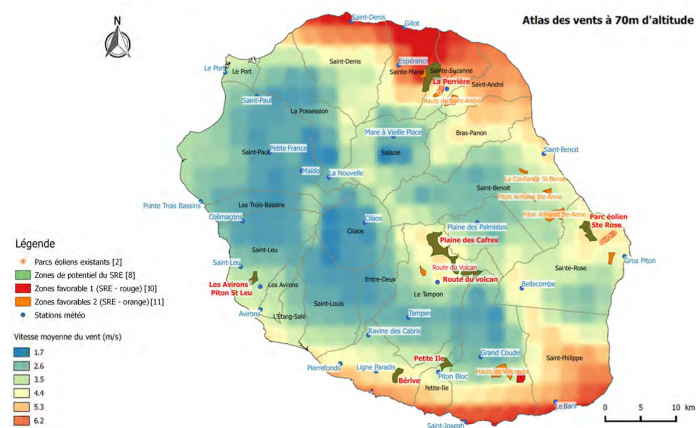
On the way to partial electrical autonomy, Réunion is replacing coal from thermal power stations (Albioma) with biomass, the majority of which is imported. Indeed, three times as much biomass is needed to replace burnt coal. However, on the island, only 30% of the necessary deposits are available locally. The remaining 70% must therefore be imported, sometimes from as far away as



Distribution of renewable energies potentially available in 2030, ADEME, Artelia, 2016



Agrienergy, agriculture and energy production, Akuo Energy



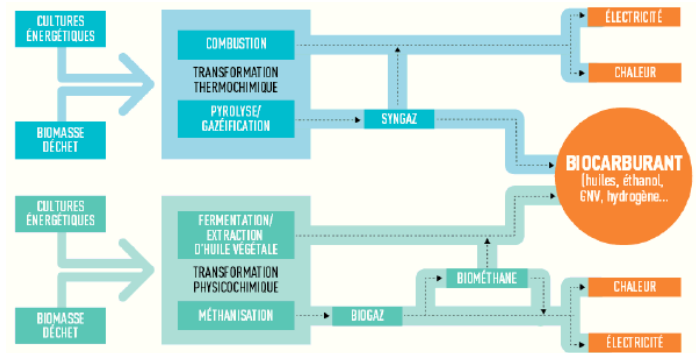
Mapping of wind power potential in Réunion, SRE



Photograph of the Takamaka II hydroelectric dam, wikipédia

Brazil or Canada. In addition to this conversion project, a 41MW combustion turbine in Saint-Pierre runs on fuel oil and bioethanol. In 2011, the installed capacity for the coal-bagasse sector was 210 MW, with an annual production dedicated to bagasse of 269.9 GW. The potential of the biomass sector can be found in wood and biogas. Indeed, the wood energy sector has a deposit of 60,000 tonnes per year, i.e. an energy potential of 230 to 250 GWh. Moreover, biogas can be used to produce electricity as well as heat and fuel.

Geothermal energy is of great interest to Réunion because it is a hotspot. At present, this sector is not being developed due to a lack of knowledge about this resource in Réunion. The marine energy sector in Réunion has a complex operating context. The rapidly deep seabed and cyclones make it difficult to exploit this sector.



Energy recovery from biomass, Information report on biomass for sustainable development, 2013, enea consulting

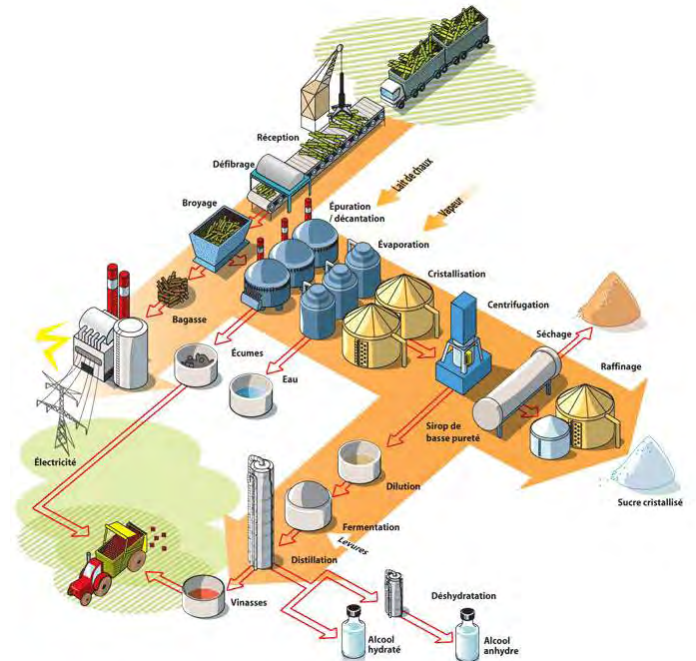
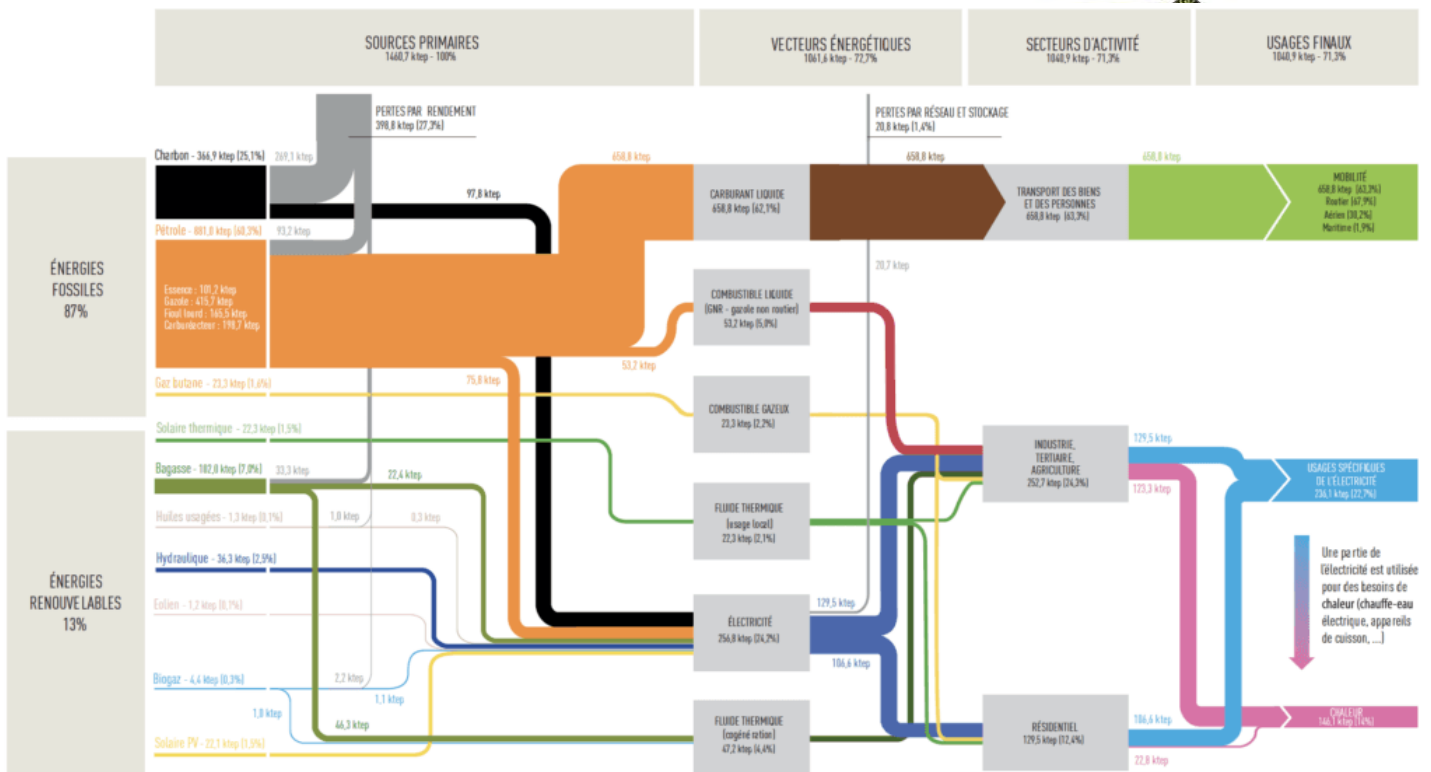


Diagram of the bagasse cane sugar rum electricity chain, habiter la réunion.re



Energetic Sankey, OER, 2017

II. The challenges of insularity in the face of climate change

C. Reducing economic and island vulnerability

3. Réunion: A tourism model respectful of the island's identity

For a long time, Réunion was an island relatively untouched by external tourism. Since the 1990s, the island has experienced strong growth in tourism, which has been the leading activity in Réunion's economy since 2000 (2% of GDP), with seaside tourism in the west and green tourism in the upper regions.

As far as tourism is concerned, it is the west coast of the island that concentrates most of the seaside tourism. This coastal stretch of about 250 km has been developed recently (after the departmentalization of the island) and in an unbalanced manner. Different models have been used for its development: the "Barachois" model of Saint-Denis, the western seaside model, the "Etang-Saléen" model as well as those of Saint-Pierre, Grand Anse and the "Sud Sauvage", and the northern and eastern models. Beaches are thus concentrated between Saint-Gilles-les-Bains and Etang-Salé. In order to limit the rate of deterioration, the Réunion Marine Nature Reserve was created. Covering 40 km of coastline, it protects a remarkable biodiversity over an area of 35 km².

Green tourism in the upper reaches of the island is an important part of Réunion's identity, with the cirques, the Piton des Neiges, the Plaines des Cafres, Plaines des Palmistes and the volcano. The cirques of Cilaos, Mafate and Salazie represent a landscape entity whose uniqueness is recognized worldwide. In 2010, Réunion was listed as a UNESCO World Heritage Site for its "pitons, cirques and remparts". After the seaside resort of Saint-Gilles, the cirque of Cilaos has been hailed as the "second most important tourist destination"⁴⁴. Indeed, the cirques are the "cradle" of the first tourism activities, i.e. thermal baths and climatotherapy. Tourism has played a decisive role in changing the way people perceive the cirques; and tourism is now the pillar of their local development. Symbolizing the "hearts" of Réunion's National Park, they are therefore at the forefront of the issues involved in linking tourism development and the preservation of natural and intangible heritage⁴⁵. The national park and the territory in general have more than 1000 km of trails, managed by the ONF (Office National des Forêts) and the General Council of La Réunion. This is why Réunion Island is such a great place for tourism.

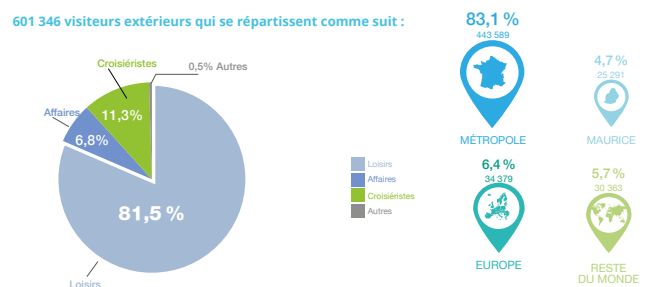
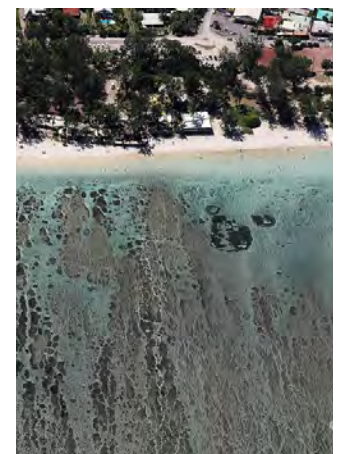
That said, Réunion remains untouched by mass tourism, particularly in comparison with Mauritius. The vast majority of tourists come from mainland France (83.1% in 2019). Moreover, Réunion suffered the full force of the chikungunya epidemic in 2006, then those of the "shark crisis" beginning in 2011, the social crisis of the "Gilets Jaunes" in 2019 and even



Saint-Pierre, Tourist office & Saint-Benoit and its coast, auteur



Barachois et its coast, auteur & West coast from the sky, Imaz press.re



Distribution of tourists in Reunion, 2019, office du tourisme

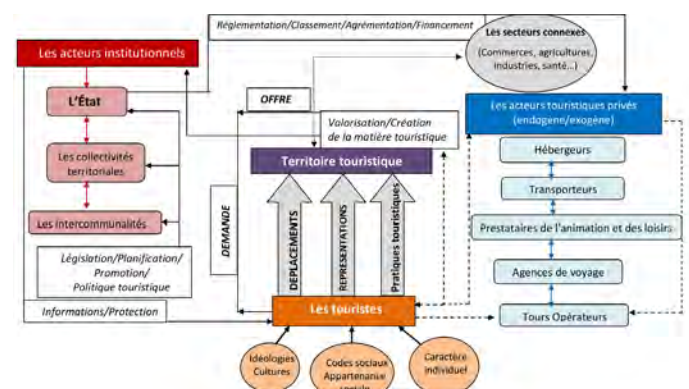


Diagram of actors in Reunion Island tourism, A. Tossem, 2015

more recently COVID-19, which have all greatly weakened tourism in Réunion. Since 2016, the IRT (Île de La Réunion Tourisme) has undertaken a vast action plan to promote the value of "Réunion as a destination" and its assets.

How can environmental protection and tourism development be reconciled, for a responsible tourism that is integrated into the island environment?

The Réunion National Park's actions in favour of a sustainable adventure tourism include the sharing of knowledge of the territory with institutional and private stakeholders, the development of eco-responsibility in nature sports and activities, and the encouraging of the emergence of an ecotourism approach in territorial projects and strategies.

A call for expressions of interest, in 2021, was launched for the establishment of an ecolodge at Anse des Cascades in Sainte-Rose. Anse des Cascades is an emblematic site for Réunion Island, with almost 400,000 visitors per year. The project concerns the creation of an ecolodge based on coastal volcanism.

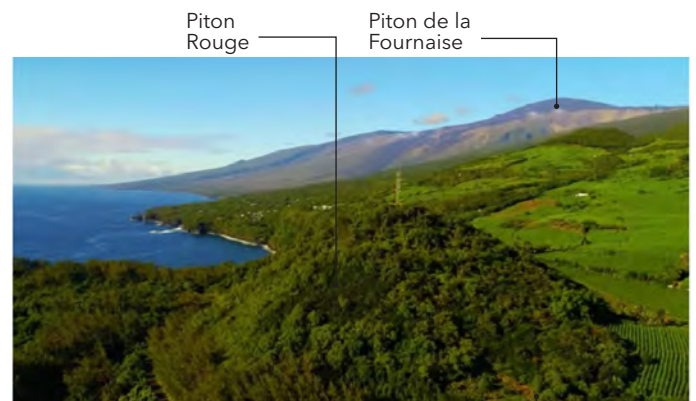
The national park has also developed ecotourism in Mafate. The objective of the national park is to meet the primary needs of the Mafate people and to make them ambassadors of this world heritage site as inhabitants involved in the preservation of the surrounding biodiversity. Thanks to the implementation of an energy system based on renewable energy sources, good waste management, preservation of biodiversity, and local production and consumption, this almost self-sufficient territory is an excellent example of ecotourism.



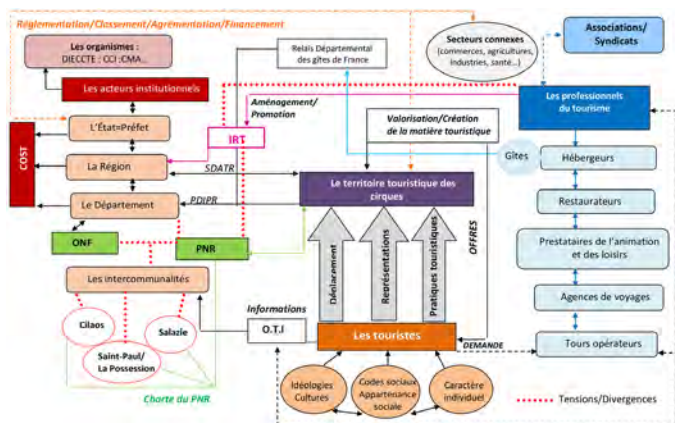
Mafate, Emmanuel Virin



Mafate, ilet Grande Place, Serge Gelabert



Eco lodge "la canopée des Laves", L'Atelier Architectes





Portrait of a farmer at La Nouvelle in Mafate, aged 80 and brother of the dean of Mafate, taken by Jean Grébert

I. Territories of interest

A. From the Etang du Gol to Les Makes

1. The CIVIS in Réunion Island

The Communauté Intercommunale des Villes Solidaires (CIVIS) is a public institution of inter-communal cooperation constituted as a Communauté d'Agglomération in 2003. The CIVIS groups together 6 communes: Saint-Pierre, les Avirons, Cilaos, L'Etang-Salé, Petite-Île and Saint-Louis.

It covers an area of 379.5 km², i.e. 15% of Réunion's territory, and is home to more than 180,000 inhabitants, i.e. 21% of Réunion's population.

On a regional scale

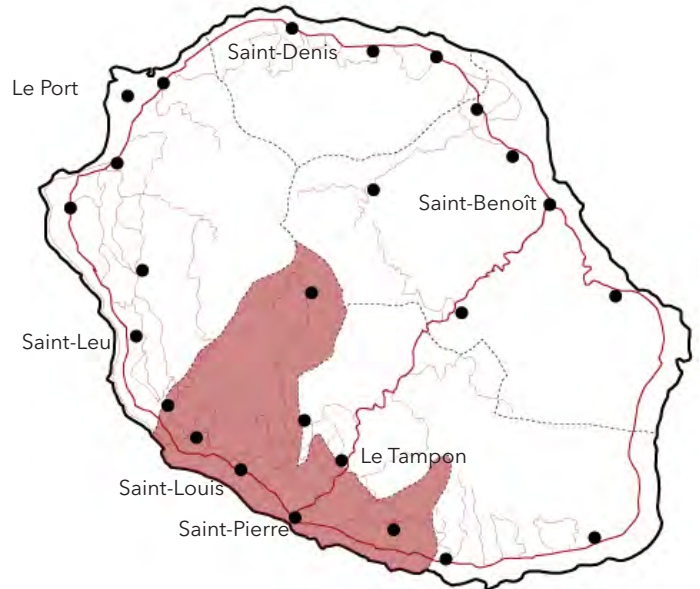
For the CIVIS territory, the SAR establishes the fundamental guidelines for land-use planning and environmental protection and includes a special chapter, the sea development plan (SMVM), which enables the application of the coastal law.

The SAR, a strategic regional planning document, in conjunction with the SCOTs, PLUs, POSs and the Charter of the Réunion National Park, aims to reconcile the demographic boom (1 million inhabitants by 2030) with the demand for housing, urban facilities and employment as well as the preservation of the area's natural and agricultural capital. The projects for the extension of the Pierrefonds waste water treatment plant and the upgrading of the Pierrefonds airport runway to safety standards fall under the SAR.

On the scale of the "Grand Sud": A true living area⁴⁶

The ten communes and their CIVIS and CASUD inter-municipalities which make up the "Grand Sud" have always presented and valued it through its territorial identity. This identity originates from the way in which the territory was populated and the way in which land ownership has been structured. This southern singularity is also accentuated by the great physical diversity of the area and the quality of its lands, which gives the Grand Sud a unique character.

As elsewhere in Réunion, the southern basin is confronted with the effects of economic and urban development. Although unavoidable, the consequences of rapid and sometimes uncontrolled social and societal change are forcing local authorities and the State to orientate regional development in the best possible way while preserving the natural wealth of the Grand Sud.



CIVIS in Reunion

municipalities. However, the evolution of the last 6 years has actually shown a decrease in the population of the territory, hence the choice of an estimated population of 360,000 inhabitants for 2035 as the basis for this SCOT.⁴⁷

The repository for all the ambitions in terms of development and planning is the very space of the Grand Sud: a natural "jewel box" made up of its cirque, its rivers and ravines, its forests, its volcano and its lands. This "jewel box" is a testament to a historic, traditional South and its extraordinary natural spaces. It is also the birthplace of a rural peasantry that has given rise to diversified agricultural and rural production systems. Finally, it is the cradle of a particular culture resulting from the know-how and production of the South's own identity. These must be protected from any abusive densification and any development that does not respect the natural and cultural environment. In this way, territorial coherence, the stated objective of the SCOT, becomes obvious. The defence of the identity of the Grand Sud, initiated by the SMEP (Civis and Casud) through the Schém, and then followed by the LEADER programme since 2016 for the upper part of the Sud, is obviously present throughout the whole of the Sud territory. The SCOT is a development instrument for the Southern micro-region of Réunion that corresponds to the SAR. The SCOT is intended to serve as a framework for projects concerning the organization of space and urban planning, housing, mobility, commercial development, economic development and the environment. The axes selected and developed for the year 2035 include:

⁵⁶ In 2018, 307,770 inhabitants lived in the ten southern

On an inter-communal scale

The CIVIS has chosen to adopt a Territory Project intended to structure the local authority's actions for the next 20 years by outlining its ambitions and its territory. A Territory Project is a cross-cutting strategic planning document composed of a diagnosis, strategies and action plans concerning several fields of competence, from mobility and the environment to town planning and others.

Since 1 January 2017, the local authority has been responsible for the creation, management and maintenance of economic activity zones, and has also embarked on an approach aimed at meeting the needs of companies through a suitable property offer. The strategy consists of marketing the various real estate products that meet the residential needs of companies. Thus, by relying on the business parks currently being developed, the local authority is seeking to develop rental workshops, business incubators, artisanal zones (particularly in the mid-slope districts) and land dedicated to hosting production companies. This last point is reflected in the

Roland Hoareau ZAC project, the first regional activity zone in the Southern micro-region. One of the challenges posed by the Loi Notre is the modernization of existing business parks, which aims to support current companies and modernize their working environment.⁴⁸

The **Pierrefonds Grand Sud** project illustrates this on several scales.

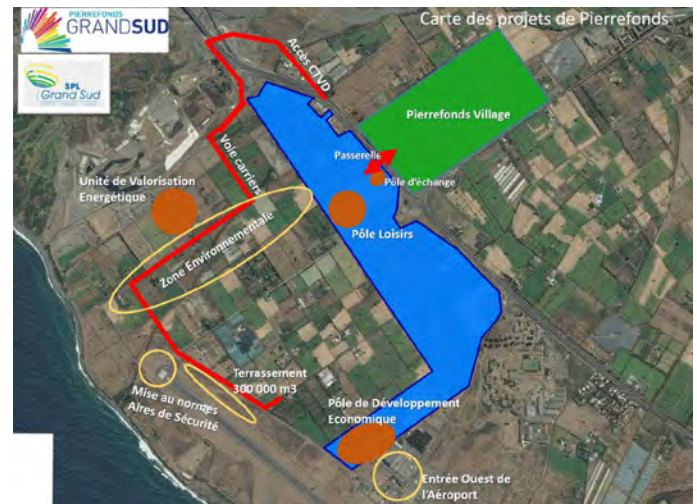
-The Roland Hoareau ZAC: an economic development zone of regional interest covering nearly 87 hectares and its extensions, namely the ZAD and the Economic Development Platform

-Pierrefonds Village: a development zone dedicated to housing and facilities in an area covering approximately 70 hectares

-The Pierrefonds Airport



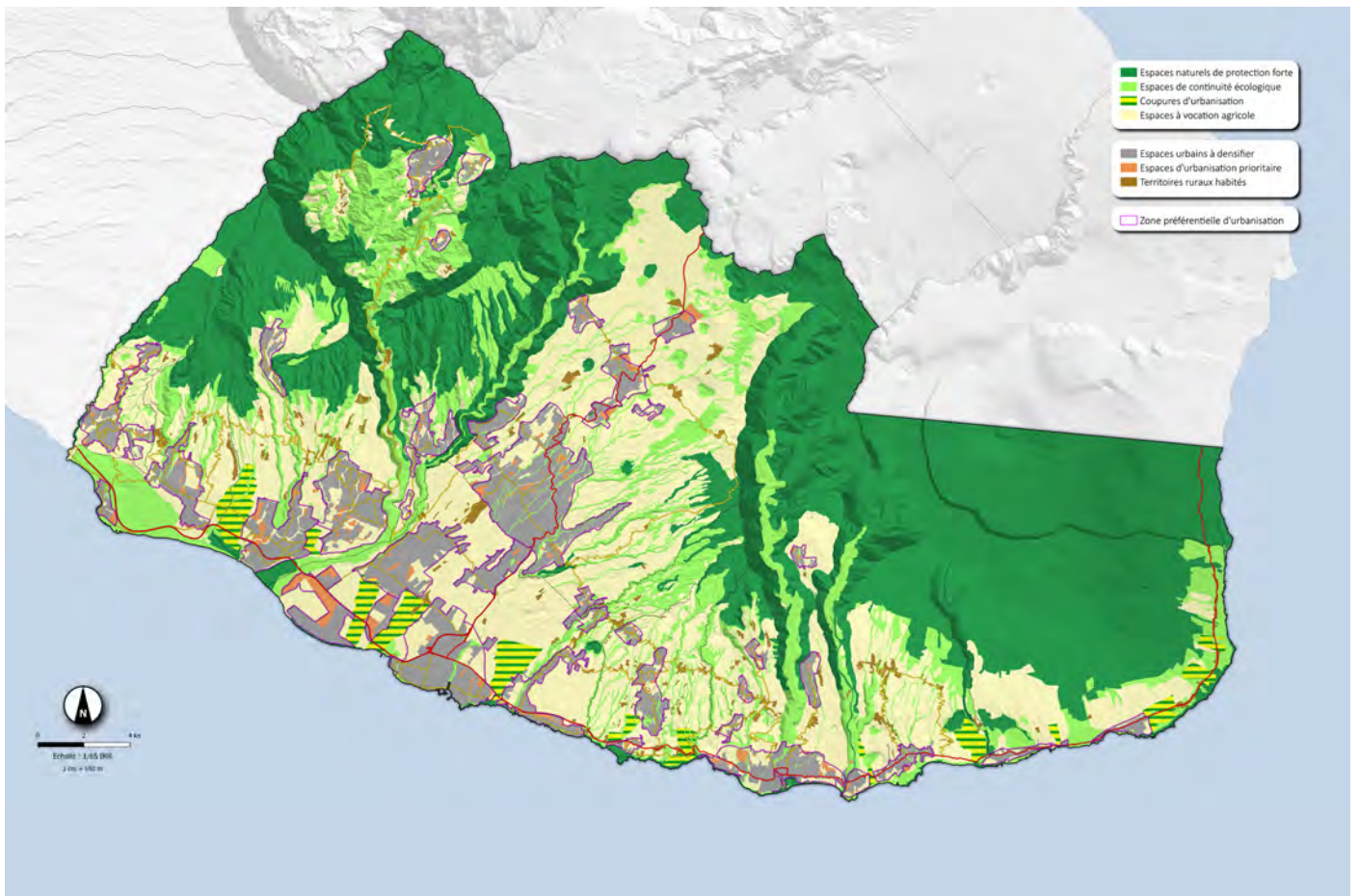
SPLA- Pierrefonds, Anakaopress



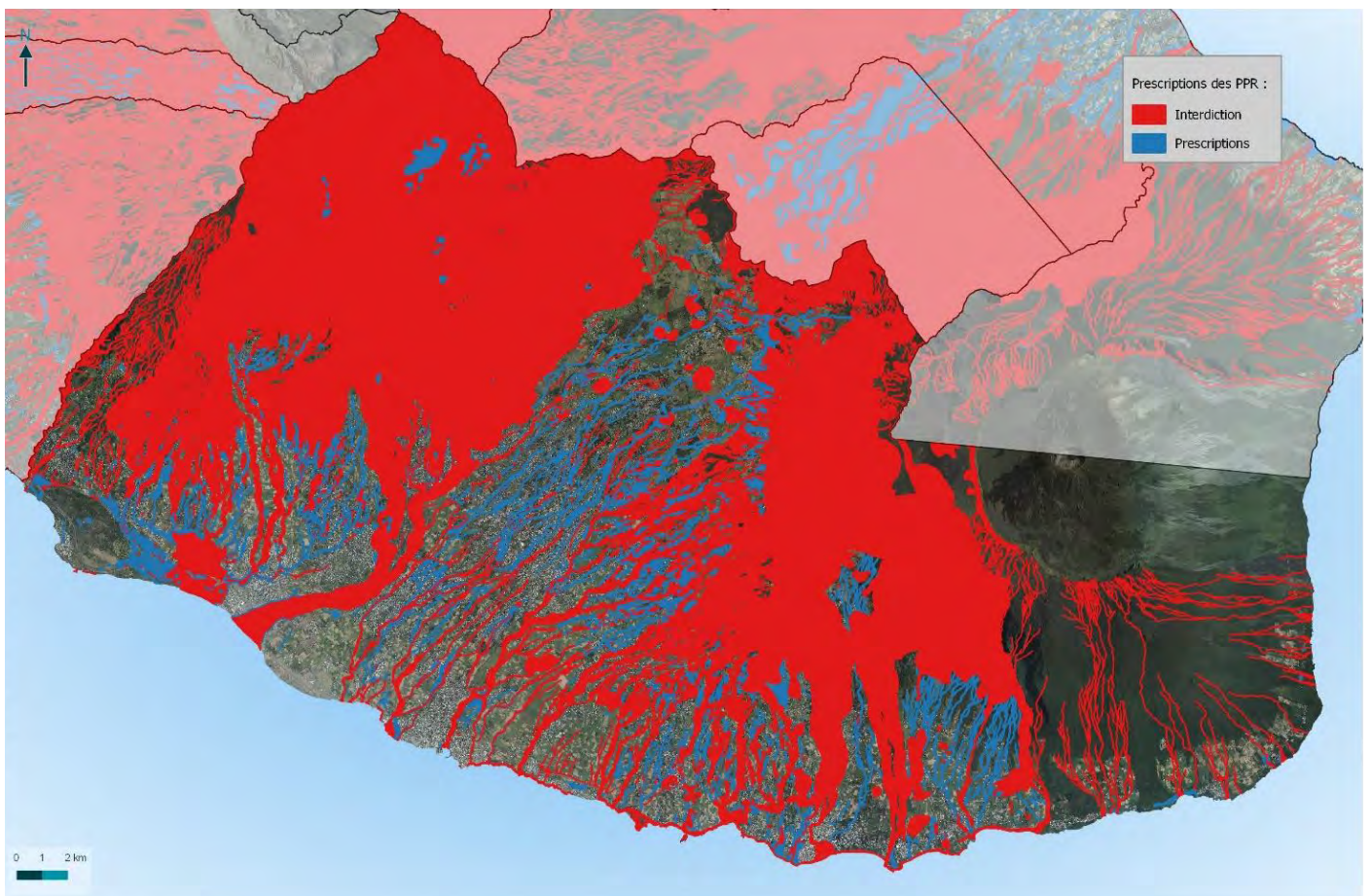
Projects map of Pierrefonds, Grand Sud

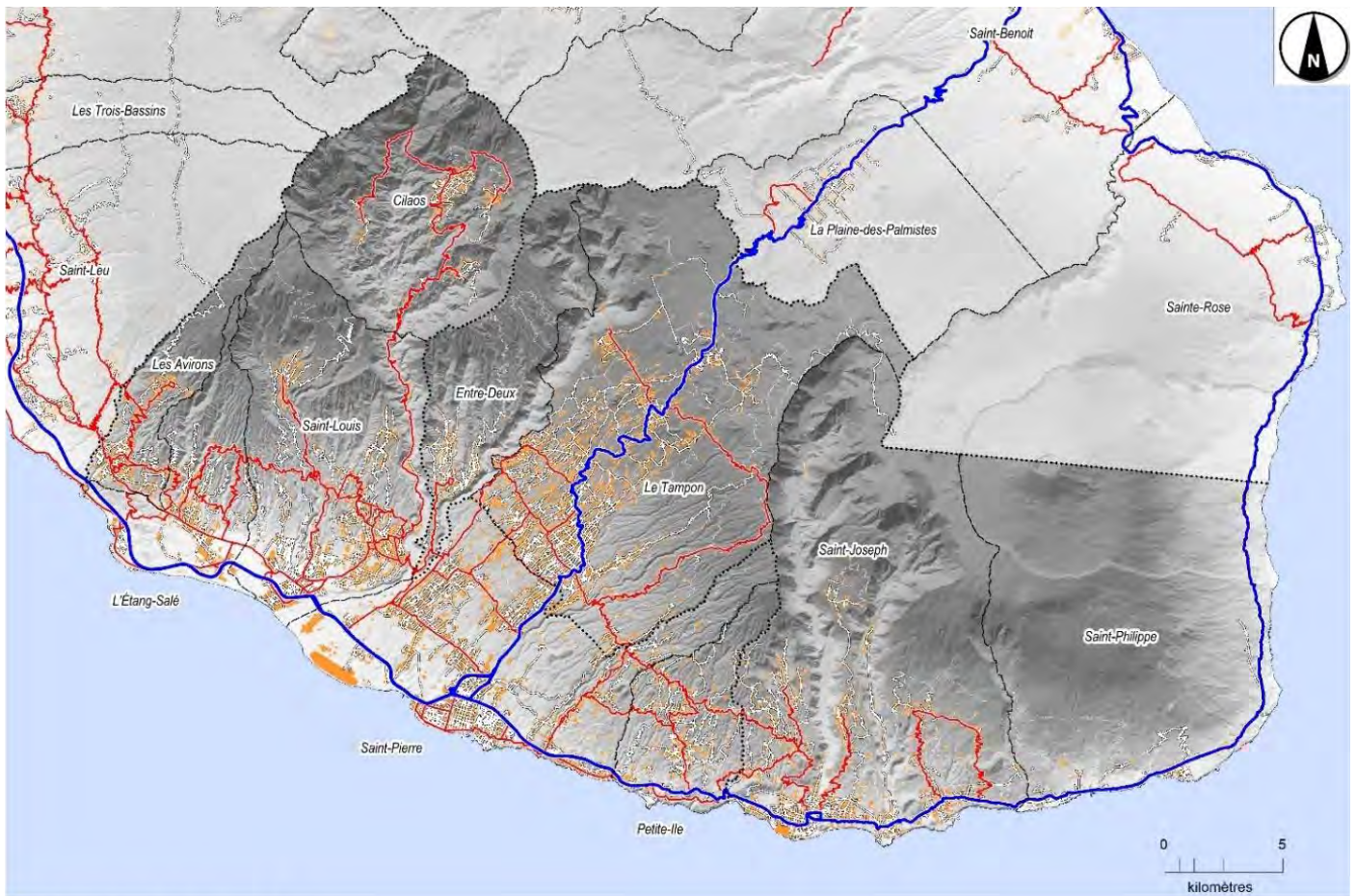


Saint-Pierre harbor, carte de la Réunion

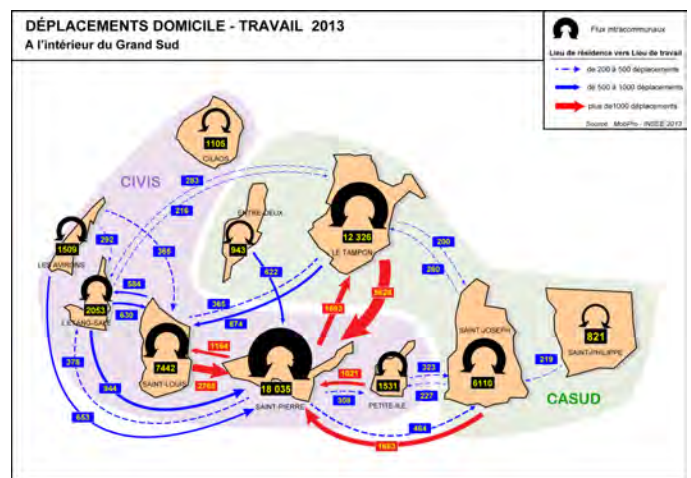
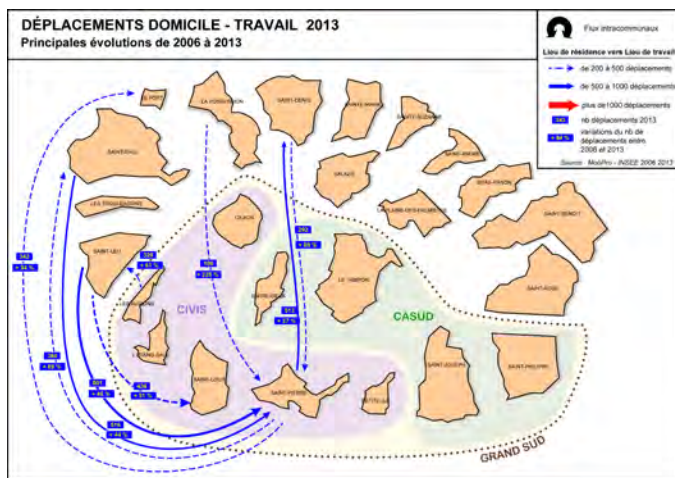


General soil destination map, SMEP Grand Sud





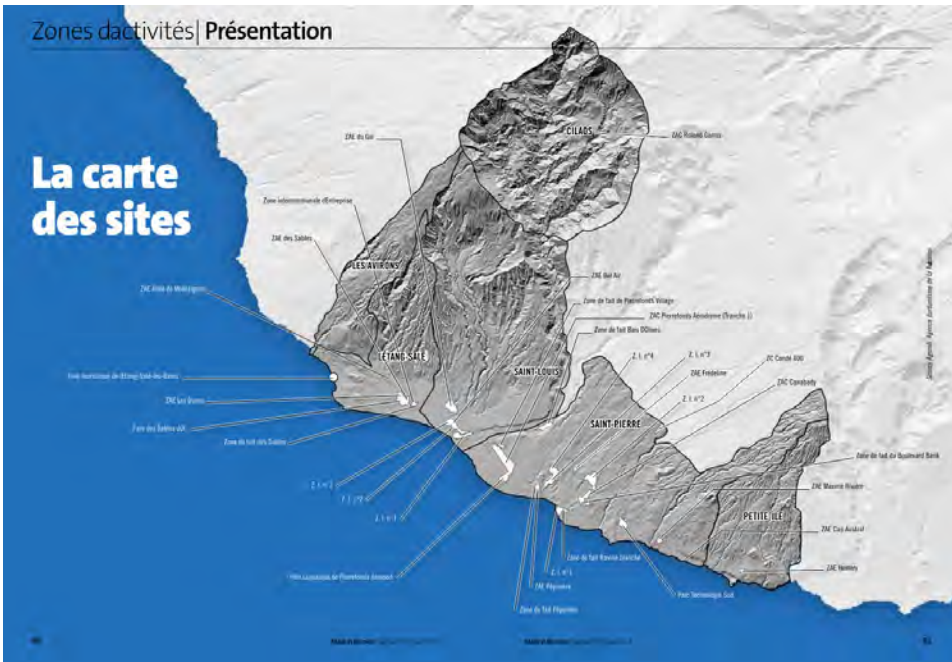
Road network map, IGN BD TOPO



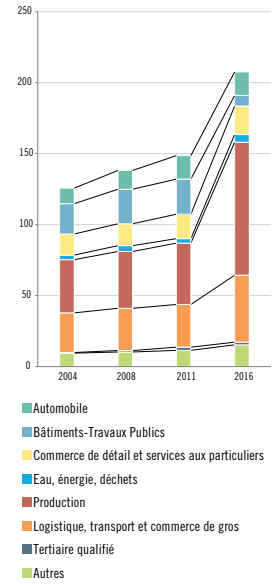
(Source SCoT Grand Sud)



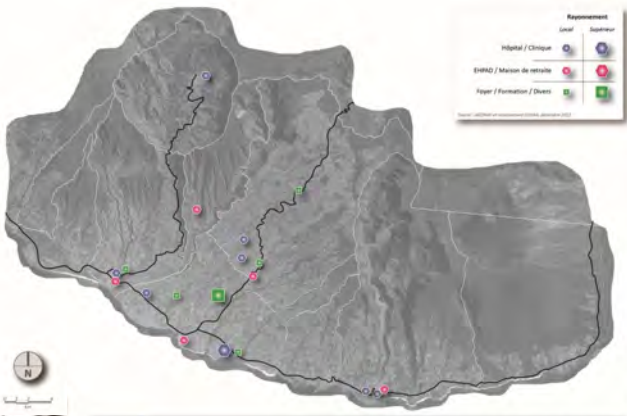
(Source SCoT Grand Sud) 59



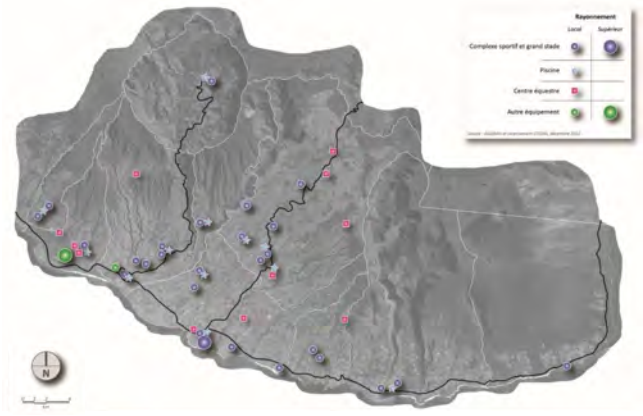
(Source Agorah)



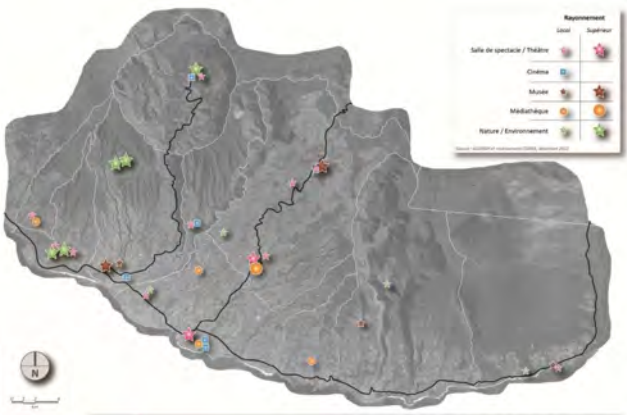
Evolution de la surface occupée en hectares par chaque filière d'activités dans les zones d'activités économiques entre 2004 et 2016 (hors zones commerciales et zones de fait). Source Agorah



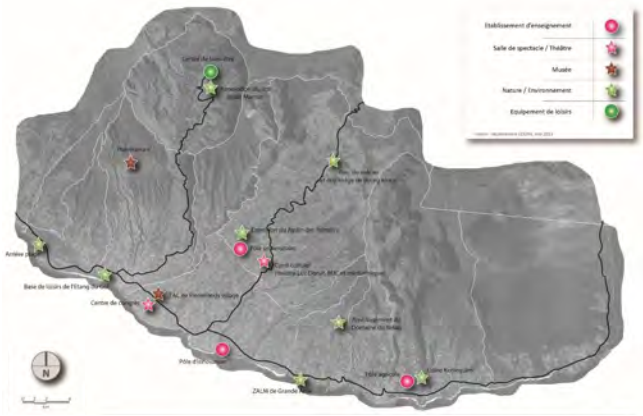
Health equipment in Grand Sud (Source SCoT Grand Sud)



Sports equipments in Grand Sud (Source SCoT Grand Sud)

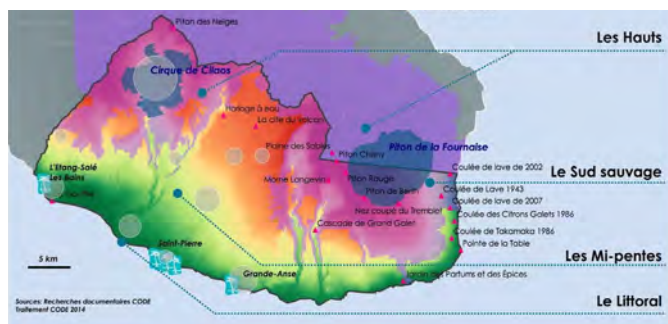


Cultural and leisure equipments (Source SCoT Grand Sud)



Large equipment projects (Source SCoT Grand Sud)

Touristic offer
(Source Recherche documentaire CODE, SCoT Grand Sud)



III. Territories of interest

A. From the Etang du Gol to Les Makes

2. The CIVIS in detail

In addition to its geographical richness with its cirque and ravines, the CIVIS is endowed with unique facilities such as the landfill site and the airfield. With more than 15,000 active establishments on 31 December 2015, and around 56,000 employees, the CIVIS territory is both dynamic and attractive. The completion of the Tamarinds Road has made it possible to reduce north-south travel times and reveal the potential of this territory.

The South, the historical granary of Réunion, is renowned for its agricultural and food-processing activities. The CIVIS has furthermore been able to develop other high added-value activities:

- Through the creation of a technopole park, Techsud, where synergies are developed between research, training and business activities;

- By supporting higher education and university training, particularly in the health sector with the development of the university hospital and the installation of the faculty of medicine in the South.

- By developing strategic sectors, airports and logistics.

In addition to its economic activity, the CIVIS is developing a diversified tourist activity with Les Makes (Creole village), the Usine du Gol, MADOI (Museum of Indian Ocean Arts), Bras de Cilaos and Etang du Gol.

Les chiffres clés de la Civis

- 37 000** Superficie du territoire en hectares
- 410** hectares dédiés aux zones économiques
- 33** zones d'activités
- 15 273** établissements économiques
- 22%** des emplois de l'île
- 180 000** habitants
- 20,7%** de la population réunionnaise

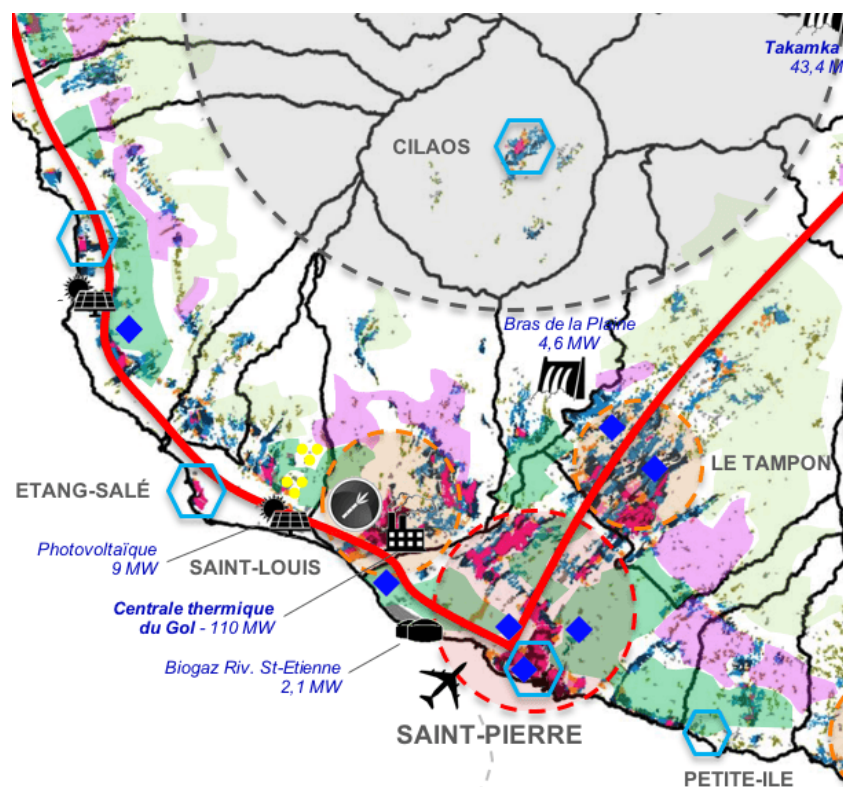


Source CIVIS



Communes of CIVIS

- Aéroport
- Port de commerce
- Port de pêche, Base navale
- ENERGIE**
- Centrale thermique
- Barrage hydraulique
- Photovoltaïque
- Biogaz
- Eolien
- ECONOMIE**
- Zones majeures d'activité et d'emplois
- Zones secondaires d'activité et d'emplois
- Espaces touristiques principaux
- Espaces enclavés ou dangereux (relief et montagnes, volcan)
- Axes de trafic majeur
- Centres commerciaux
- AGRICULTURE**
- Usine sucrière
- Canne à sucre
- Polycultures
- Elevage
- Cultures fruitières

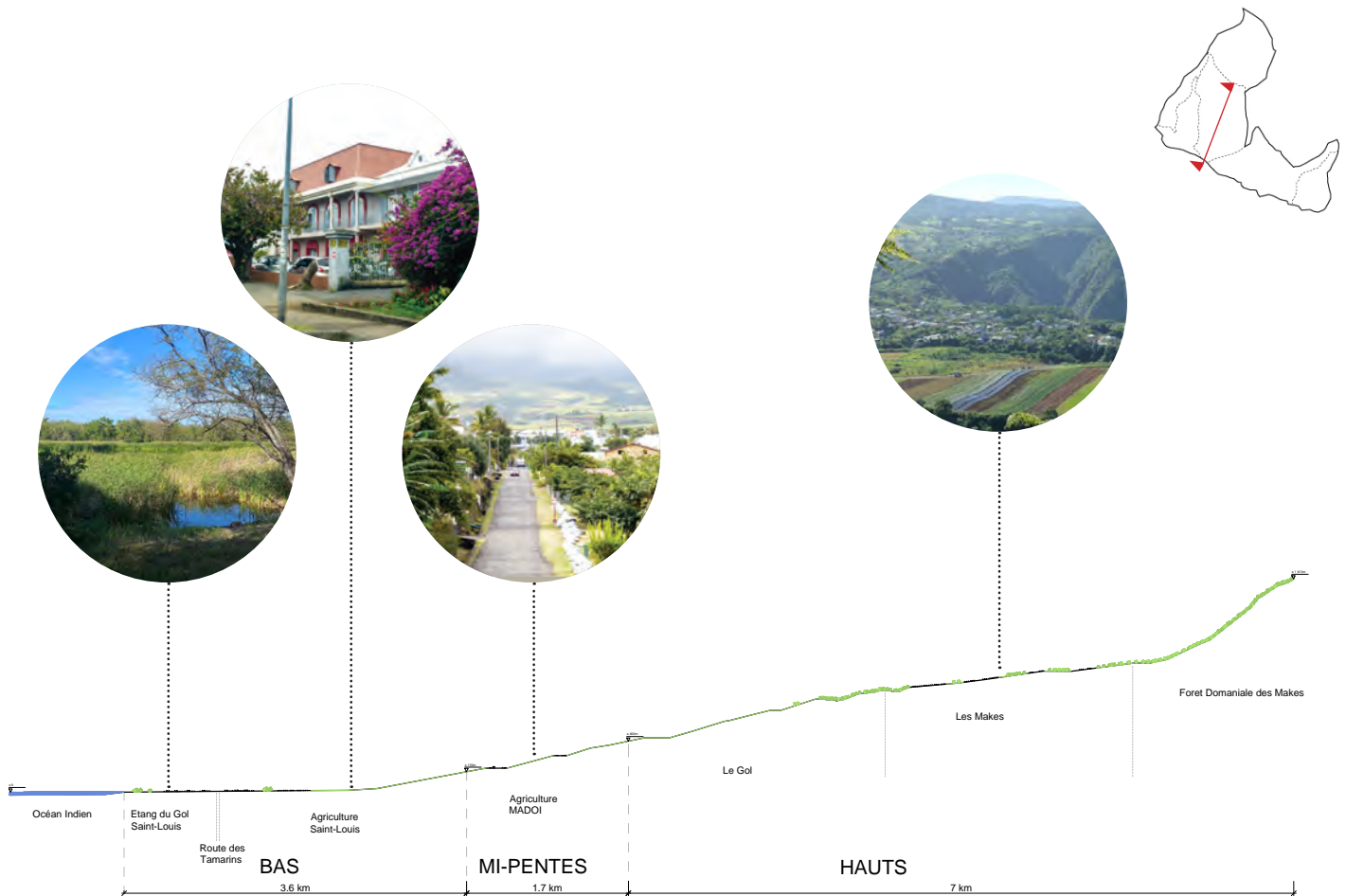


Economic map of CIVIS, habiter la réunion.re

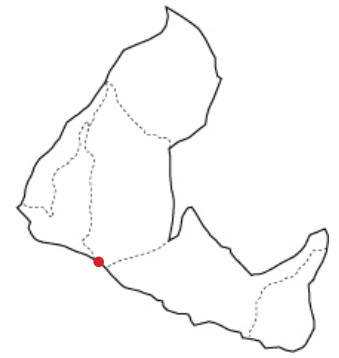
III. Territories of interest

A. From the Etang du Gol to Les Makes

3. Territorial section : From the Etang du Gol to Les Makes



The Etang du Gol: Between the ocean and road infrastructure



Location

The Plaine du Gol, located on the right bank of the Saint Etienne River between the outlet of the cirque of Cilaos and the ocean, is a bay formed by river and sea flows and separated from the ocean by a barrier of alluvial deposits, an amalgam of pebbles and sand that forms a natural dyke and prevents drainage. This is how, on the border of the communes of Saint-Louis and Etang Salé, the Etang du Gol was formed. It was formerly fed by five ravines: the Deschenez, des Cafres, Petit and Grand Maniron, and the Gol.

The lake, surrounded by sugar cane crops, offers a welcome breathing space to the local population, who can come and relax, picnic or walk in a pleasant setting where Moka cattle graze in peace. Two gravel pits, dug for the construction of the national road in the late 1970s, complete the site.

Historical context and its management

The colonization of the south of Réunion Island began at the beginning of the 18th century, with the development of coffee production. In 1719, the first concession near the Etang du Gol was granted to the Desforge-Boucher family. In 1747, the son Desforge-Boucher had a castle built on the edge of the pond, made of ashlar, where it is said that "under its rich porticoes, French taste was mixed with Asian luxury". The castle was abandoned when sugar cane cultivation began. All that remains today is the prestigious coconut tree avenue that led to it.

As the sugar cane fields multiplied in the Plaine du Gol, the Gol Sugar Factory was built by Mr De Kerveguen on its present location.

At the beginning of the 20th century, the lake was very popular with boats. It was possible to fish in the lake: carp, mullet, goby (*cabot*), freshwater shrimp (*chevrettes*), freshwater crabs (*carangaises d'eau douce*), etc. It was also possible to harvest cattail (*massettes*), the rushes used to stuff the "Gol chairs", which were famous throughout the island. This activity continues to this day.

The Gol wetland is a complex interweaving of ecosystems subject to numerous threats and pressures. It is now "framed" by two artisanal and industrial zones, a wastewater treatment plant, various classified industrial installations such as the sugar factory, numerous farms and the national road which blocks upstream water runoff. For all these reasons, the water of the Etang du Gol

has long been unsuitable for bathing and is increasingly being invaded by aquatic plants. At certain times of the year, the entire expanse of water is uniformly covered by water hyacinths and lettuce, causing fish mortality. For a better management of the wetlands, both for its submerged and terrestrial areas, a single operator has been chosen in the commune of Saint-Louis. An agreement bringing together seven signatories sets out the framework for its intervention. It is valid until March 2014.

Flora and fauna

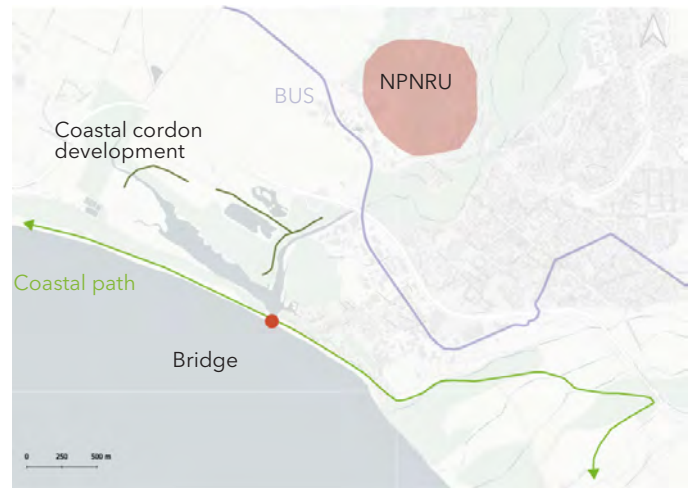
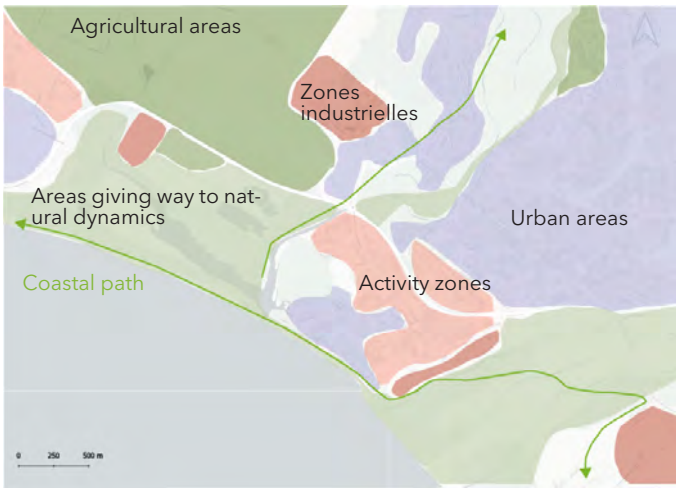
During periods of high swells or heavy rainfall, the water level in the lake rises and the barrier beach is broken or submerged, allowing exchanges between ocean water and lake water. These variations in water level, the mixing of fresh and salt water, and the fluctuations in the rate of flow favour the diversity of natural aquatic and terrestrial habitats.

The lake area, bordered by dry and wet meadows and mudflats, is gradually closing in as a result of lake infilling and the diminution in rainfall. The wet meadows of brown rice, a rarity for the island, are becoming even scarcer. As in all natural coastal habitats, invasions by exotic species are abundant, most notably the Faux Poivriers or Brazilian pepper trees.

About twenty bird species have been observed in the Gol wetlands. Twenty percent of these species are of high heritage value, including the moorhen, the Réunion grey white-eye and the striated heron. The site is an important breeding area for this species, with up to 120 active nests per season.

The rest of the species are exotic: the Madagascar Red Fody (*foudi*) with its bright red plumage, the black-headed weaver (*tisserin gendarme*) whose colonies adorn all the tamarind trees on the site, the Red-whiskered bulbul which nests in the forests of Brazilian pepper tree, the Common myna (*martin triste*) which follows the Moka cattle for the insects they attract, etc.

The water zones are no less rich, containing 19 of the 24 native fish species and 6 of the 10 native macro-crustacean species found on the island.

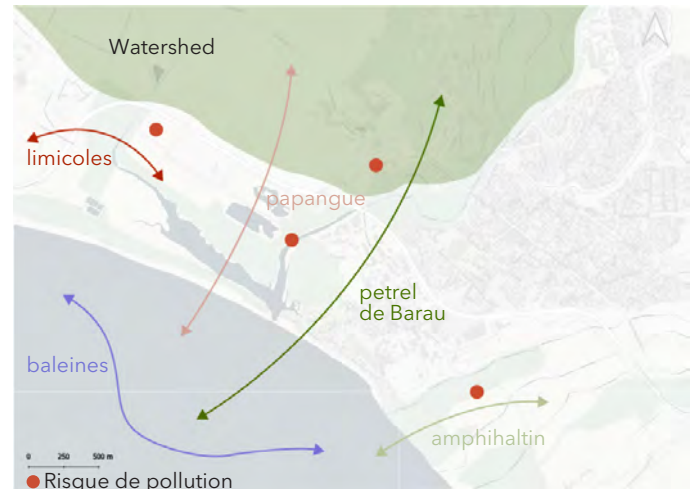
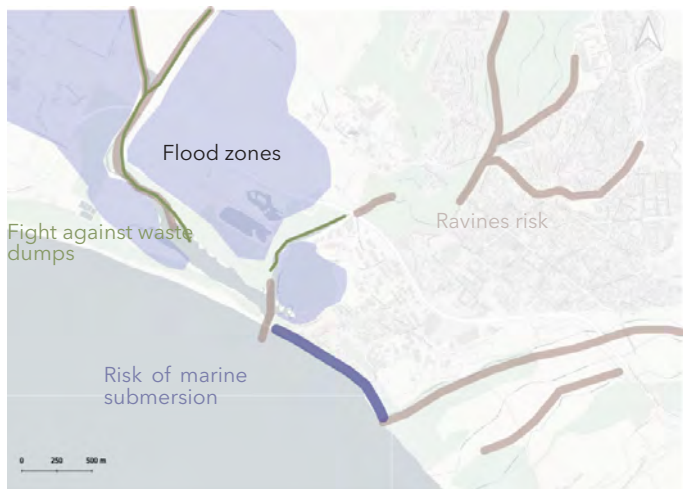


Economic issues

Potential for qualified employment, in the areas of Nature, Nature and industrial space management, services through appropriate qualifying training.

Social issues

Pedestrian links between urban areas and natural areas, coastal link and to the heights.



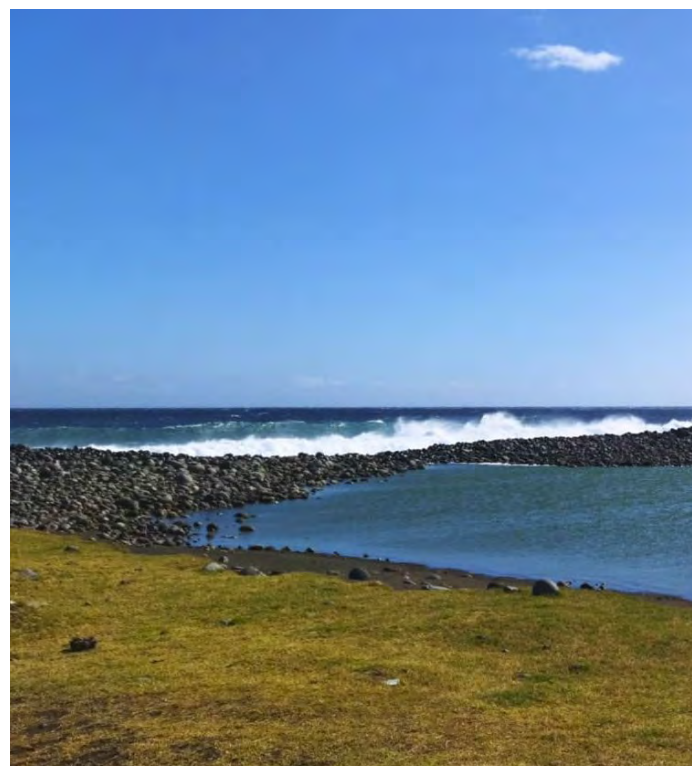
Natural risk issues

Management of the network of gullies, fight against PEE, collection of waste and illegal dumps, weirs and containment.

Environmental issues

Water quality and resource management
 Management of public spaces: waste collection with brush clearing, use of BRP to promote infiltration and reduce green waste management. PCAET actions, Nature in the city, Social ties, Soft mode routes for the coastal part of the area (erosion of the coastline and marine submersion).

Source Sébastien Hermann



Saint-Louis: A city centre subject to strong pressures⁴⁹



Location

In terms of hydrography, the city centre of Saint-Louis is flanked on its western side by the Ravine du Gol and on its eastern side by the Saint-Etienne River, which has a large bed and experiences relatively sudden rises in water level during heavy rainfall.

The town centre is relatively flat, although on each side of the area there are more constrained reliefs due to the presence of the Ravine du Gol and the Saint-Etienne River, which are located largely on the town's fringes. Characteristic of the coastal zone, the city centre is marked by a road divide, the National Road. The city centre of Saint-Louis is accessible from this road, which continues to Saint-Pierre.

Historical and demographic context

Between 1957 and 2010, urban development initially progressed along the roads, then continued within the housing clusters and finally entered into a process of densification characteristic of city centres, which has resulted today in a continuous and dense urban fabric (density of the urbanized zone: 22.2 dwellings/ha) but with a relatively low coverage.

The current demographic situation of the city centre of Saint-Louis is that of a fairly young population with a high proportion of families with children.

Environmental pressure



A small part of the eastern end of the town centre is covered by a Type 2 Natural Zone of Ecological, Faunistic and Floristic Interest (ZNIEFF), which relatively corresponds to the banks of the Saint-Etienne River.

The town centre is crossed by a waterway, the Ravine du Gol, which runs through a limited part of its upper end. The Saint-Etienne River also flows through its eastern border.

Land and property pressure

The urban structure is made up of a social rental stock



which remains low with 297 dwellings, i.e. 15% of all registered dwellings. It is therefore mainly characterized by individual housing.

Furthermore, according to the inventory of precarious and substandard housing areas (ZHPI) drawn up over the 2006–2008 period and which is currently being updated, 192 substandard buildings have been identified in the Saint-Louis study area. These precarious and sub-standard buildings are scattered throughout the area.

In the city centre of Saint-Louis, 33 public facilities were identified in 2015. The town centre hosts all types of facilities. Administrative facilities are the most represented.



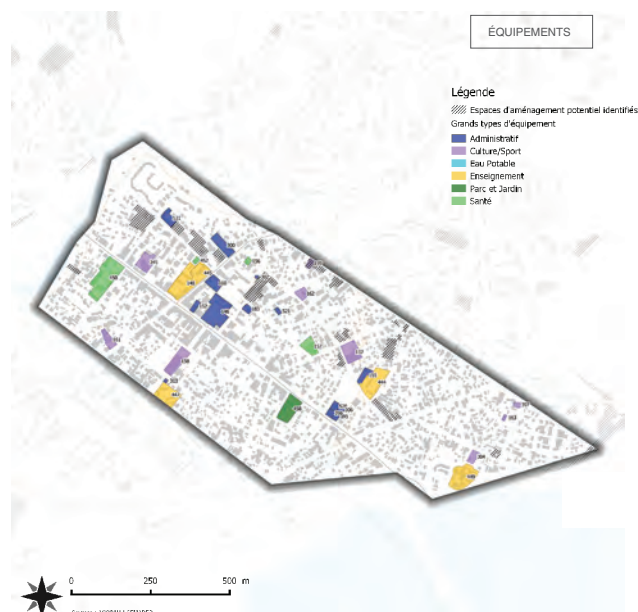
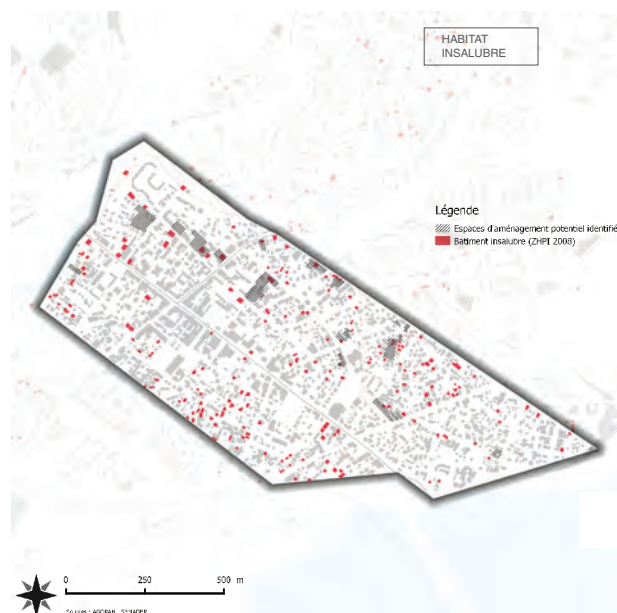
The typology of existing facilities reflects fairly well the demographic structure of the area's inhabitants, which is largely made up of families with children.

Road and transport pressure

The road network is present throughout the city centre. The former national road N2001, known as Avenue Principale, runs through the centre. This is the main road in the district and allows it to be crossed from east to west, while also linking the city centre to National Road 1, a major axis allowing for the connection between the different communes on the west side of the island. There is also the passage of Departmental Road 20 in the upper half of the district, at the level of the town centre. This road connects the city centre of Saint-Louis to the various districts in the upper part of the commune, as far as Les Makes. In addition to these main roads, there are also numerous communal service roads which facilitate travel between the different areas of the town centre. The most important roads are linked to the Avenue Principale and, for the most part, cross the entire district.

The city centre has no bicycle lanes. However, some traffic lanes are comfortably wide and, combined with a gentle topography, allow for relatively safe car-bike cohabitation. The introduction of electric or non-electric bicycle hires offers a new means of soft travel. There are three stations in Saint-Louis.

In terms of alternative mobility, the city centre of Saint-Louis is relatively well served by public transport. There are several bus routes totalling just over 20 km in length.



The mid-slopes: A strategic area⁵⁰



Location

The district is accessible via National Road 1, either from the south via Saint-Pierre or from the north via Etang-Salé. This area is organized around 5 main routes, which also serve as access points to the district. The Gol-Roche-Maigre district has a particular topography as it is separated in two by the Ravine de Bellevue to the west and the Ravine Barrage to the east. Marked by these two ravines, the area's relief is representative of a topography characteristic of the island's foothills.

The urbanization of this area has gone from almost non-existent to extremely dense. In fact, in a period of thirty years, the number of buildings in this area increased tenfold between 1957 and 1980. The development of the district has mainly been focused on densification and on building in the gaps. The central area is still preserved from any urbanization. The construction of individual dwellings, most often ground level or two-storey houses, is the most common in this area. However, small collective housing projects have also been carried out. Thus, the urbanization of the heart of the city is characterized by a mix of housing typologies with the presence of single-family houses as well as small and large collective housing estates. Since the 1980s, urbanization has spread to the mid-slopes where land is still available.

Like the town centre of Saint-Louis, the demographic context of the mid-slopes of La Roche Maigre is that of a fairly young population with a high proportion of families with children.

Environmental pressure

The Gol-Roche-Maigre area is criss-crossed by a network of ravines that constrain its planning and development potential, as they dictate the layout of the area. The central part of the district is unusable due to the crossing of two ravines, which create a particularly rugged relief. This district falls under the Risk Prevention Plan for its coastline portion (erosion of the coastline and coastal submersion). The majority of these areas are classified as natural and agricultural spaces. Ecological continuity areas are protected and located on either side of the ravines that criss-cross the area.

Land and property pressure

This district, according to the SAR, is a mainly urban area. In addition to having a topography favourable to the implementation of development projects, this district is also expected to be densified and therefore will be able to accommodate new constructions.



According to the urban architecture defined in the SAR, the commune of Saint-Louis has been identified as a secondary centre. Urban development projects must therefore have a minimum density of 50 dwellings per hectare, i.e. a building potential of 495 dwellings.

The number of facilities is low (3.9 facilities/1,000 inhabitants) in this district and is affected by the topography. They are unevenly distributed and difficult to access.⁵¹

Moreover, there are very few shops in the district, with two centres near the stadium and further west. This is why the inhabitants of Saint-Louis have to go to the city centre of Saint-Louis for their shopping needs.

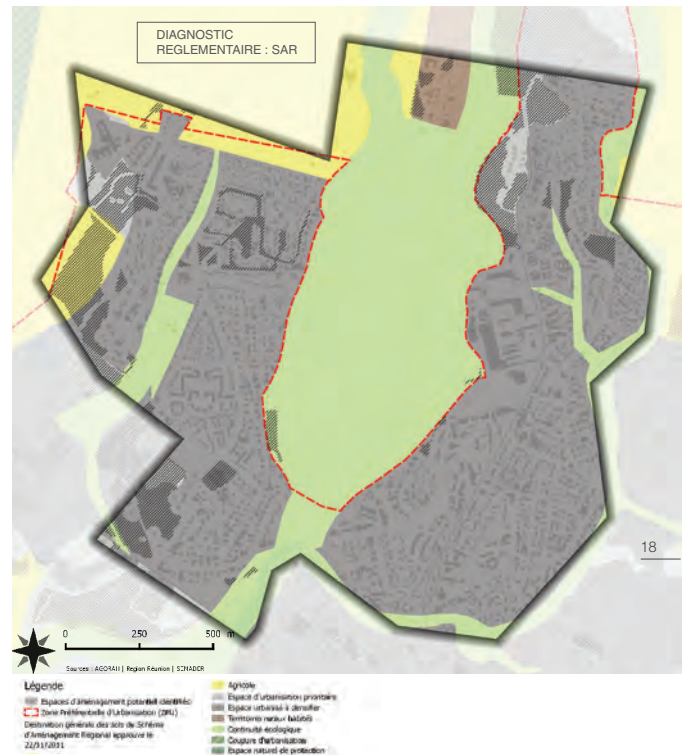
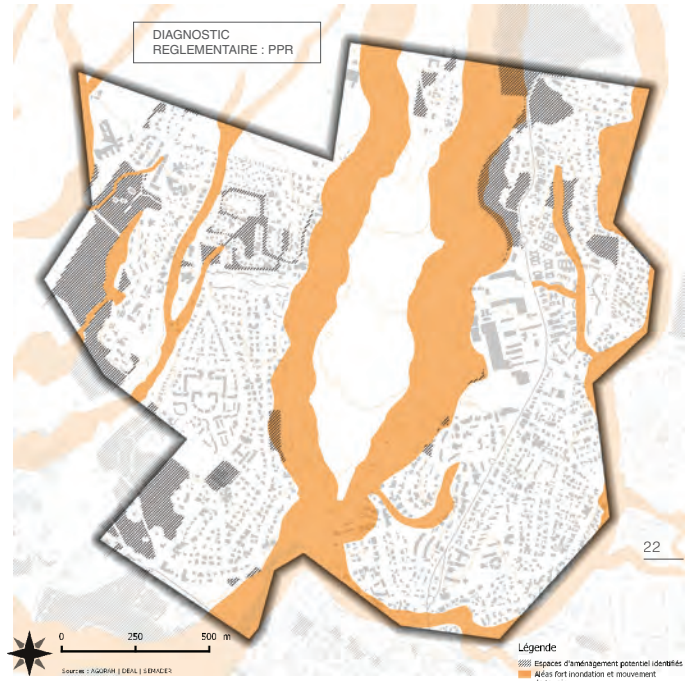
Road and transport pressure

The district's road network is fairly dense and reflects its urbanization. Several main roads can be identified: The N1C to the south of the district, the D20, rue Leconte Delisle to the west, the N5, rue n°5 Saint-Louis to the east, the D3, route Hubert Delisle to the north, and the Che-

min Maison Rouge which runs between the two ravines.

Several communal roads provide a more extensive network of routes and access to the district's various built-up areas. There is a significant number of dead ends, which provide access to residential areas. The road system in Saint-Louis is well structured, providing an intricate network of roads and easy access to the various central areas of the district. However, there are few parking spaces, most of which are located along the main roads. Moreover, several roads are congested at peak times because they are the only roads that provide links to the coastal area, in particular National Road 1, which is the main road linking this district to the Saint-Pierre employment zone.

Public transport, with its five bus lines, covers 15.7 kilometres within the district. As a result, the public transport system covers all of the district's various residential areas, connecting them to each other as well as to the city centre of Saint-Louis and neighbouring communes. However, the district does not have any paths suitable for soft modes of travel. Indeed, there are only a few walkways and there are no cycle paths.



Les Makes: An extraordinary site



Location and population

A small cirque in the southwest of the island, closed off by the Bois de Nèfles mountain range, the village of Les Makes is situated at an altitude of between 900 m and 1200 m. It is situated roughly 10 km north of Saint-Louis and accessible via the winding D20 roadway.

Its population, predominantly agricultural, is around 2,500. The tranquillity of this village, where several services (town hall, church, post office, school and medical service) are available to villagers, attracts excursionists and passing tourists.

The history of Les Makes

The name Les Makes comes from the Maki lemur, a variety of lemurs originating from Madagascar and introduced to Réunion Island in the 1840s. This lemur was quickly exterminated from the forest of Les Makes by hunters around 1900. Historians also suggest that the name may have originated from a tool called a "macque" used to pound hemp.

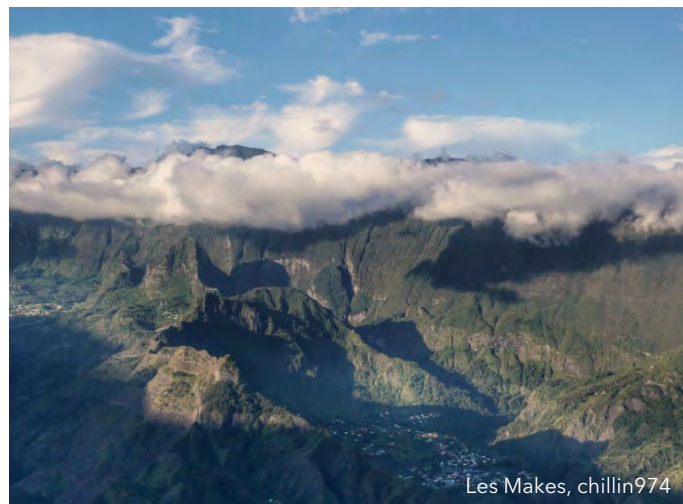
The village of Les Makes developed around fruit, food and livestock farming, and was difficult to access. In 1946, Father Favron, who had been the head of the parish of Saint-Louis since 1943, decided to build a wooden chapel in the village. The wooden chapel of Les Makes was destroyed during the cyclone of 1948 and was replaced in 1957 by a small rectangular church made of stone and concrete. The Church of Les Makes is dedicated to the Holy Guardian Angels.

This high plateau became a place of residence for many workers from the south fleeing the heat wave. In addition to fruit crops, geraniums and dairy farming, the area is distinguished by its two types of forest, natural and replanted.

Climate and flora

Les Makes has a special climate due to its relief. The cloud cover can be important from midday on, but the nights are clear. Due to its geographical location in the southwest of the island, the region of Les Makes is sheltered from the humid trade winds.

Today, geranium cultivation has been replaced by livestock, diversified crops (market gardening, fruit trees) and the forest of cryptomerias. Due to its particular geological situation and its climatic uniqueness, the Bon Accueil is a forest of coloured woods of great ecological interest. Outcrops of shiny black basalt can be seen: this is the lava on which the forest was established.



Preserved for many years, the Bon Accueil forest is now a refuge for a large number of plant species (tree ferns or "fanjans", *Tan rouge/Weinmannia tinctoria*, *Corce blanc/Homalium paniculatum*, *Bois de pomme/Syzygium borbonicum*, *Bois maigre/Nuxia verticillata*, *Affouche/Ficus reflexa*, *Bois de rempart/Agarista salicifolia* and *Change écorce/Aphloia theiformis*) and animals (Réunion stonechat/oiseau Tec-Tec, blackbird/merle, Réunion grey white-eye/Oiseau-blanc and Mascarene paradise flycatcher/Oiseau-la-vierge).

Tourist sites

Les Makes is an ideal place for walks and offers hikers and tourists a wide range of leisure activities thanks to its forest, its hiking trails (Maïdo, Tapage, Tévelave, Grand Bénard) and its sites (Fenêtre viewpoint, Bon Accueil forest, Plaine Bois de Nèfles). In addition, 900 hectares of this massif have been classified as a biological reserve in order to protect the island's rare and remarkable heritage.

III. Territories of interest

B. The watershed of Saint-Leu's bay

1. The TCO in Réunion Island

The West Coast Territory (**TCO**) is a public institution for inter-communal cooperation which was converted into a Communauté d'Agglomération in 2001. The TCO comprises 5 communes: Le Port, La Possession, Saint-Leu, Saint-Paul and Trois Bassins.

The TCO has a population of 213,494 inhabitants (i.e. 24.8% of Réunion's population) and covers a total area of 53,606 hectares (i.e. 21% of the territory).⁵²

On a regional and territorial scale

For the TCO territory, the SAR is the main planning instrument for its development. It sets the priorities for the development, protection and promotion of the regional territory and its natural, historical, material, cultural and human heritage.

In accordance with the SAR, the Schéma de Cohérence Territoriale is the reference document which defines the TCO's strategic choices in terms of development and planning over a 10-year period. By deliberation of the community council on 21 December 2016, the Grenelle SCoT of the TCO was approved. The SCoT, a strategic planning document, specifies the general guidelines for the spatial organization and restructuring of urbanized areas, the areas to be protected, the major balances between urban areas and areas to be urbanized and natural or forested agricultural areas. The legislative objectives of the SCoT include:

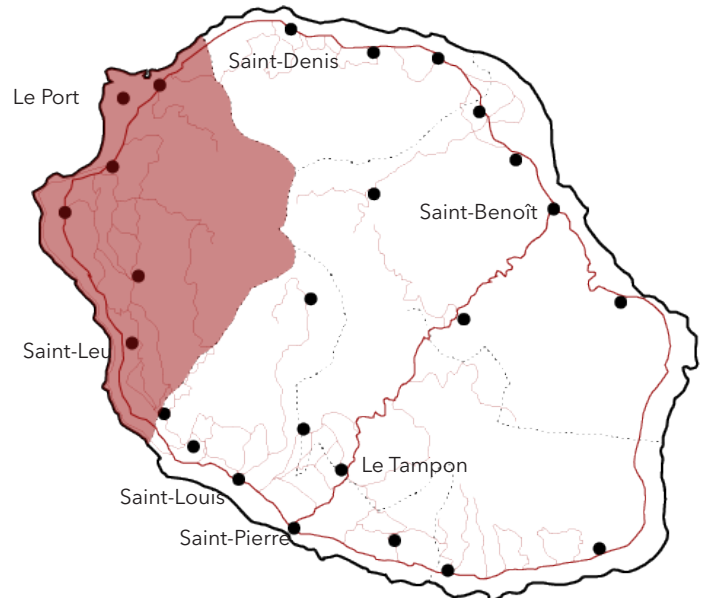
-The balance between urban renewal, urban development and the development of rural areas; the preservation of areas allocated to agricultural and forestry activities; and the protection of natural areas and landscapes;

-The diversity of urban functions and the social mix in urban and rural housing;

-The economical and balanced use of the territory; the preservation of the environment; the prevention of risks, pollution and nuisances.

The TCO's Agglomeration Project (2013-2023)

The Agglomeration Project "determines, on the one hand, the guidelines that the agglomeration sets for itself in terms of economic development and social cohesion, town planning and development, transport and housing,



TCO in La Réunion

agement [...] and, on the other hand, the measures that will enable these guidelines to be implemented" (Law of 25 June 1999).

The TCO began drawing up its Agglomeration Project in March 2003. It sets out the Communauté d'Agglomération's work programme within its various jurisdictions.

The four main areas of focus are:

-To structure the territory in order to meet the challenge of growth

-To optimize economic activity and employment

-To construct a project for sustainable development and living

-To affirm the identity and culture of the territory

On an inter-communal scale

The TCO has chosen to adopt a Territory Project. This approach aims to collectively build the roadmap for the development of the western territory over the next 20 years. The TCO aims to involve the territory's inhabitants in the creation of this key framework for action: a citizen consultation will be carried out from 30 August to 30 November 2021, in conjunction with the territorial diagnosis phase.

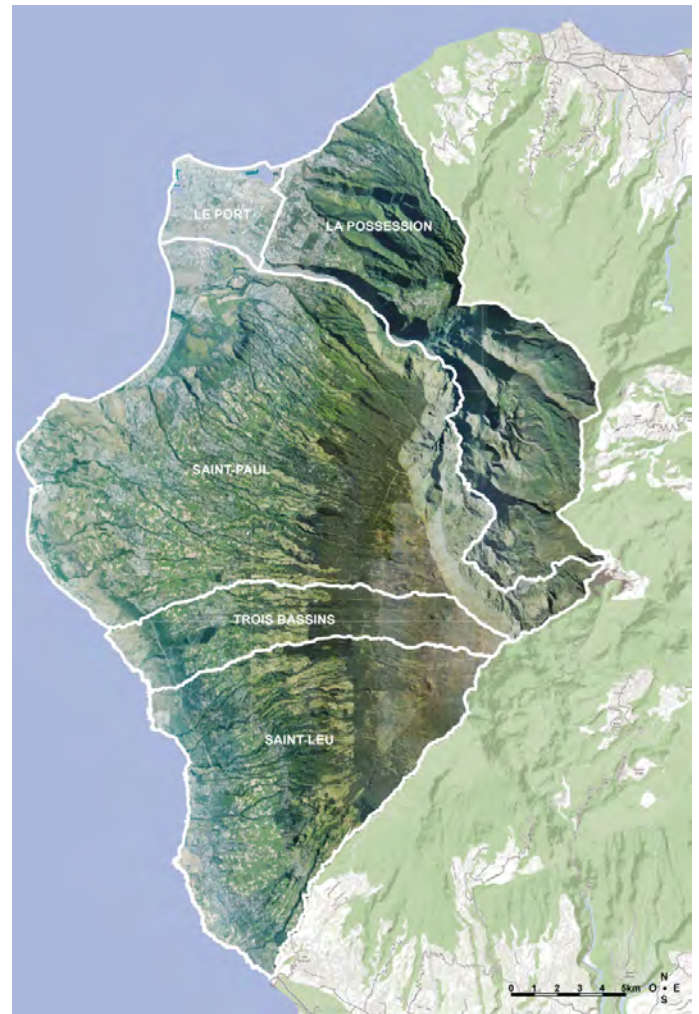
In concrete terms, the aim is to define the major issues, the objectives to be achieved and the operational means

to achieve them through a short-, medium- and long-term action plan. The key objectives of the Territory Project are:

-To ensure development that corresponds to the territory's assets and major climatic, economic and social challenges, based on discussions with all stakeholders (inhabitants, elected representatives, businesses, etc.);

-To establish a common framework to ensure balanced and coherent development, at the inter-communal and communal levels, while taking into account the diversity of the western territory;

-To effectively guide the formulation and implementation of the various spatial planning policies, including those conducted in conjunction with Europe, the State, the Region and the Department. To give meaning to public action and clear perspectives to all the actors in the territory.



Carte du TCO, source TCO



Vue aérienne du TCO, source TCO

III. Territories of interest

B. The watershed of Saint-Leu's bay

2. The TCO in detail

A heritage of history and nature

From the lagoons and the Piton to the savannah, the ravines and the remparts, this great landscape enjoys national recognition. The preservation and enhancement of its natural spaces are key issues. From the plantations of the East India Company, the sugar factories and the "marronage" of years past to the constitution of the forty or so districts today, this territory bears both the assets and the weaknesses of its development: an exceptional biodiversity, unique in the world, faced with an urban sprawl that is reaching the limits of the island's coastal development potential. Historically, the agriculture sector has experienced many crises. Installed on the best plateaus of the Bas and the Hauts, it is vulnerable to climatic risks. The cradle of the island's population, the West Coast Territory is the most popular coastline for both Réunionese and metropolitan tourists: its living environment, its heritage and its exceptional landscapes have garnered it its reputation.⁵³

An economic driver⁵⁴

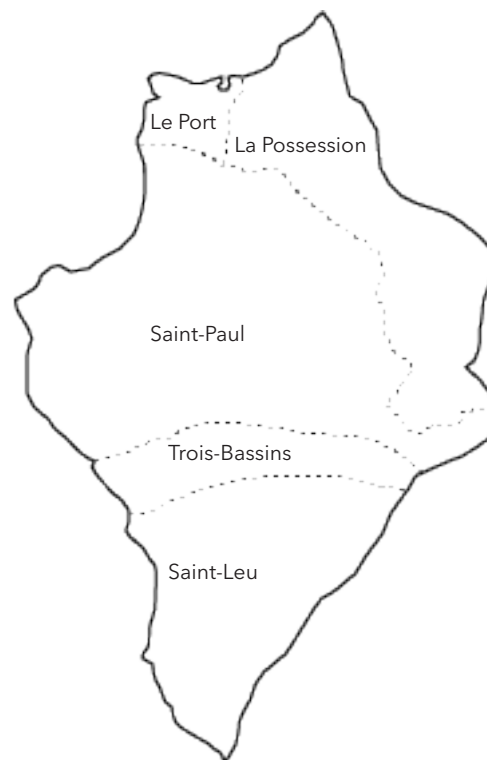
The West is a highly strategic area thanks to the industrial and commercial port, a vector of employment and the only maritime entry point for goods and merchandise to the island. The dynamic demography of Réunion suggests a favourable development of port activity in the future, which could have an impact on the territory through the creation of indirect jobs. In this way, the West retains its local leadership role in terms of tourism and the port and logistics economy.

A territorial and social divide⁵⁵

The urban fabric extends over 14% of its total surface area and is a source of permanent conflict with agricultural and natural spaces. Urban land, which has always been a scarce commodity in this highly sought-after area, has become very expensive as a result of the development of activities and housing. The urban fabric is divided up in the following manner.

The coastline, home to 45% of the population, reflects the economic, tourist and commercial activities that take place in the territory. In the future, thanks to the Ecocity, one of the largest land reserves in Réunion will be developed (800 ha of developed land).

At the same time, 55% of the population, scattered across the mid-slopes and the Hauts, lack the conveniences of urban life.

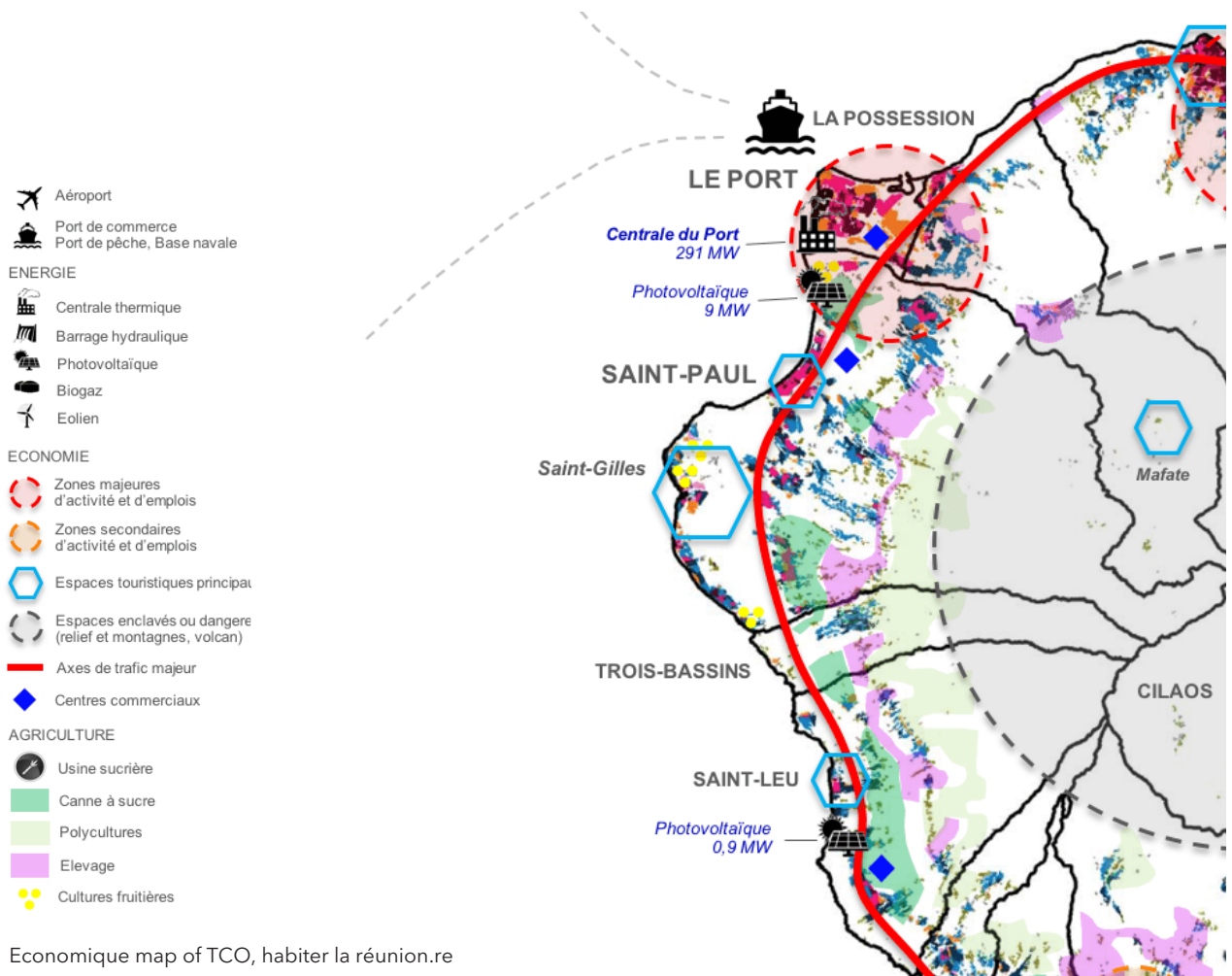


Communes of TCO

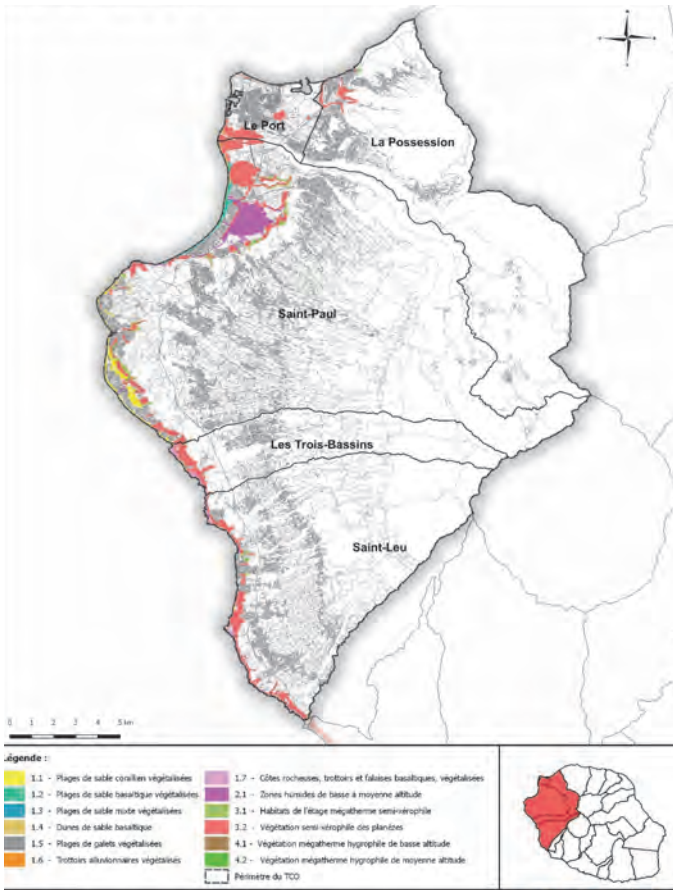
terms of the development and structuring of a territory that is 20 years behind in terms of utility networks and other facilities. The majority of the population lives in areas where there are very few jobs and where no major structuring facilities exist.

The everyday experience of development is that of a "machine" that generates significant travel and operating costs for basic public services (waste, school and urban transport, water, sanitation, etc.). This territorial paradox puts a strain on the budgets of both local authorities and households. Unemployment, precariousness, social transfers, and substandard housing scattered in the Bas and the Hauts remain constant problems.

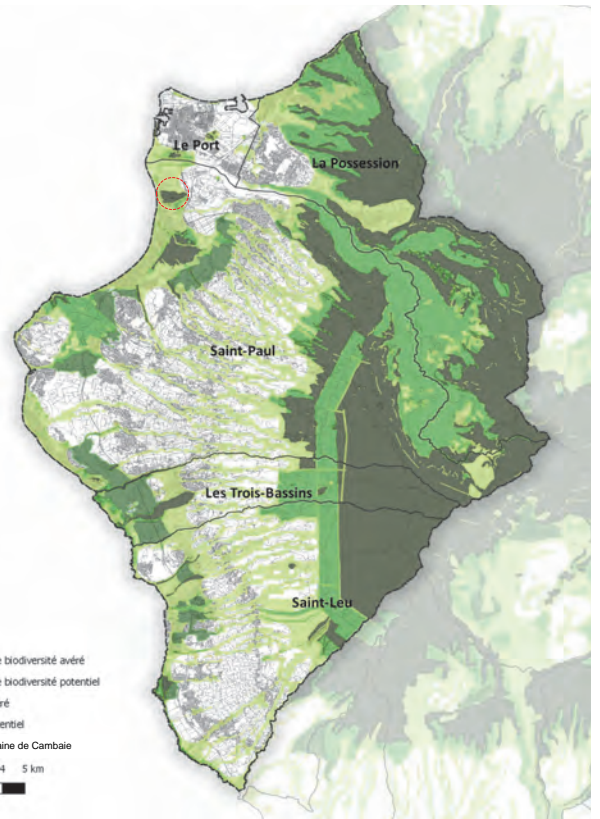
Although attractive, the Western micro-region is one of the most impoverished in Réunion. Despite its numerous assets (land, free space, structuring projects and building sites, a town in the making, potential for commercial and tourist development, diversified agriculture), the territory still has difficulty "transcending its strengths" and pursuing its desired development path.



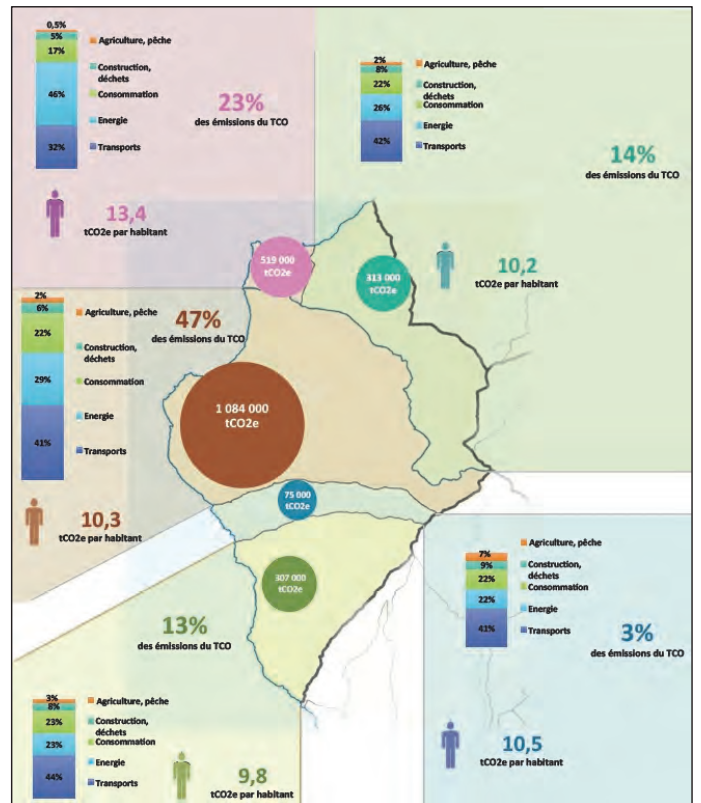
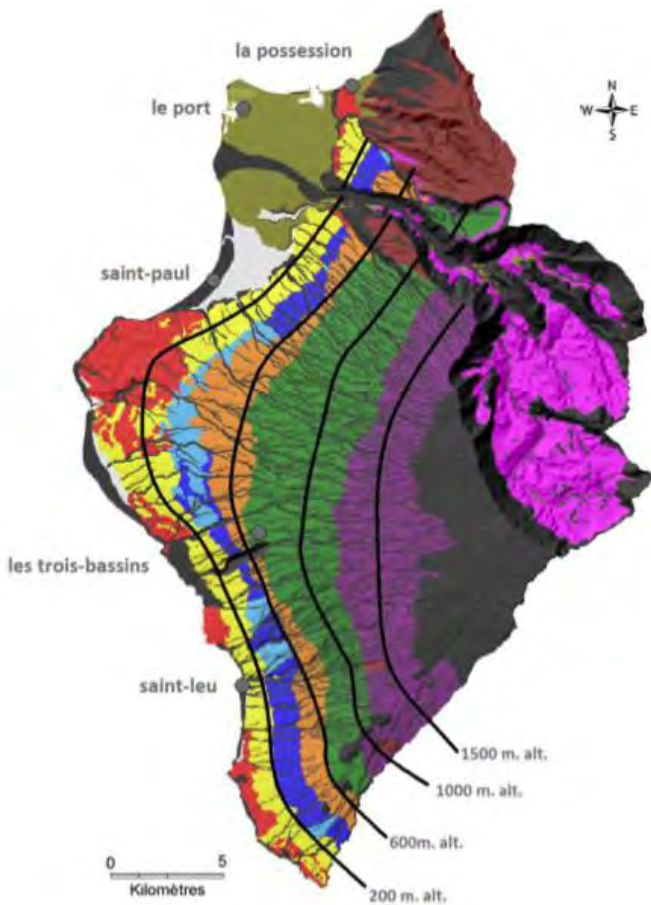
Sky view of Saint-Paul, Imaz Press Réunion



Coastal habitats, SCOT TCO, DEAL, BD TOPO



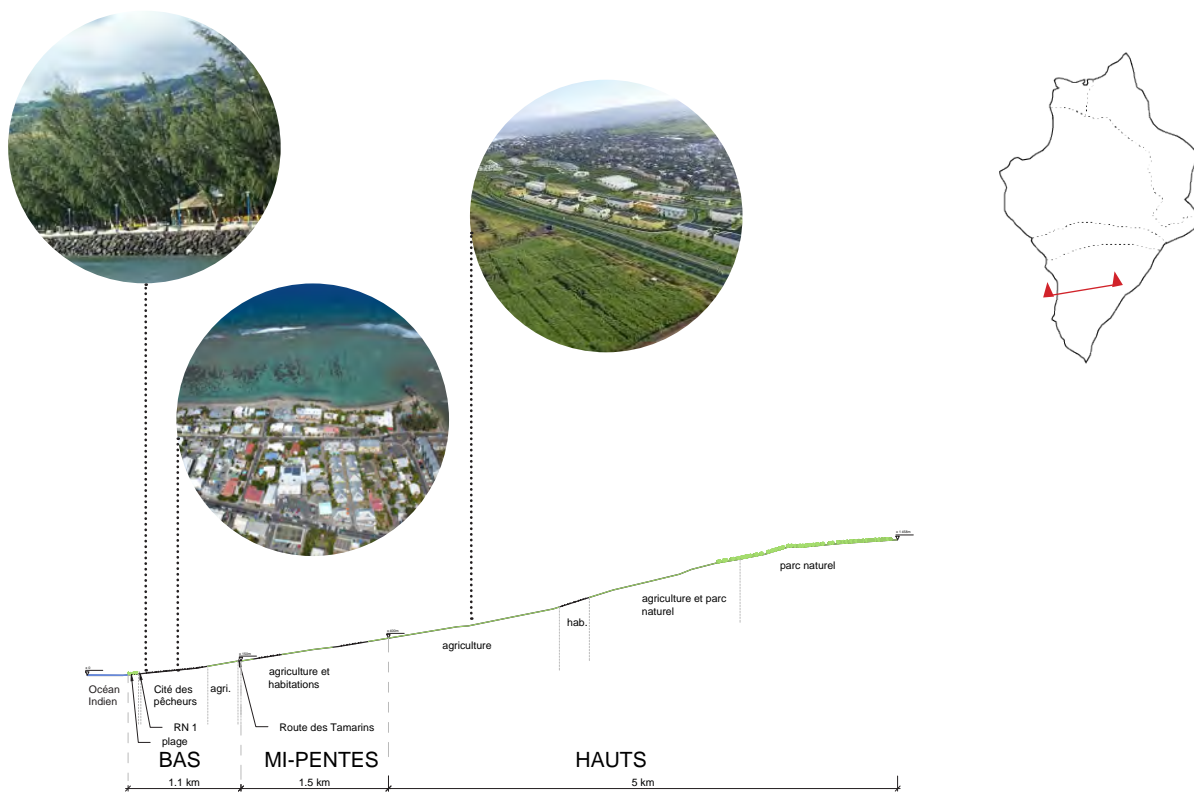
Synthesis of biodiversity reservoirs and ecological corridors, Ecovia, DEAL, BD TOPO



III. Territories of interest

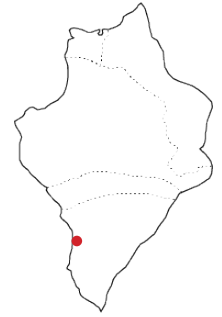
B. The watershed of Saint-Leu's bay

3. Territorial section : The Cape ravine



Skyview of Saint-Leu, Imaz press réunion

The revitalization of Saint-Leu's city centre⁵⁶

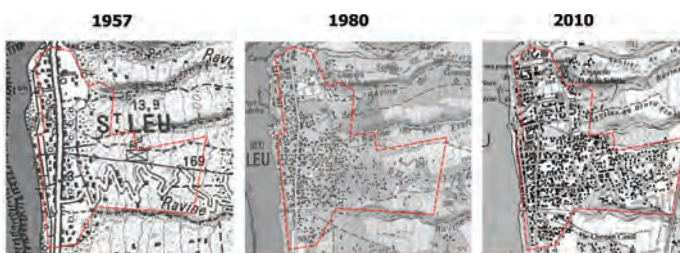


Location

The town centre of Saint-Leu extends from the coast to the interior of the island, over an area of 91.47 hectares. The main surrounding districts and towns are La Chaloupe, Le Plate, Piton Saint-Leu. This area is also close to the communes of Trois-Bassins, to the north, and Les Avirons, to the south. The town centre of Saint-Leu is served by various transport links and is extremely accessible. Its main axis is the rue du Général Lambert. It crosses the town centre and is the main entrance to the area from both the north and south of the island. The former main roadway in the west of Réunion has been decongested since 2009, the year the Tamarinds Road was opened. The area is also accessible via the rue Haute, which runs parallel to the rue du Général Lambert and bypasses the town centre. Finally, Chemin Dubuisson, which is a departmental road, provides links between the centre of Saint-Leu, its mid-slopes and its Hauts, while also offering easy access to the Tamarinds Road.

The territory of the town centre of Saint-Leu is intersected by a fairly large network of ravines. In fact, there are no less than 4 ravines. From north to south, they are: the Ravine du Grand Etang, the Ravine Claude, the Ravine du Petit Etang and finally the Ravine des Poux. The Grand Etang and Poux ravines are the most important. The topography of the town centre is heterogeneous, with a flat coastal area and a relief that quickly rises to the mid-slopes.

Historical and demographic context



In 2010, the urbanization of the centre of Saint-Leu became even more pronounced. As a matter of fact, over the last thirty years, the number of buildings in this area has increased tenfold. In particular, there has been a significant increase in the density of the town centre and the coastal area. The most visible change is the significant urban development around Chemin Dubuisson. As the available land in the city centre is becoming scarcer, buildings have been built higher up and on spaces that are both available and easily accessible. New transport links have made it possible to provide better access to the area and therefore to develop numerous buildings around them. The current demographic context of the



town centre of Saint-Leu is that of a fairly young population with a high proportion of working people.

Environmental pressure

The territory of the centre of Saint-Leu is criss-crossed by a network of ravines that limit its potential for development. These ravines therefore dictate the layout of the area and are subject to a Natural Risk Prevention Plan (PPR).

Three Natural Zones of Ecological, Faunistic and Floristic Interest (ZNIEFF) are located in the study area. Two of these are Type 1 ZNIEFFs, representing almost two hectares of protection. The southern part of the study area is the most restricted. In fact, there are two ZNIEFFs of Types 1 and 2 established around the Poux ravine.

The PPR for the town centre includes restricted and "prescription" (constructible under constrained conditions) zones. Although the majority of these areas are listed as natural and agricultural areas, a large part of the seafront is subject to risk and is classified as a U zone. Only one parcel of land has been identified as being located in this zone, which is both designated as an area suitable for urban development and as a restricted area due to risks.

Land and property pressure

Nearly 87% of the city centre area is embedded in the

urbanized area. The density of housing is quite high, with almost 21 dwellings per hectare within the urbanized area. A social mix is present with a 9% share of social housing located mainly at the northern entrance. New social housing developments are emerging at the southern entrance. The housing typologies are therefore quite varied, as there are small and large collective housing estates as well as private housing in the form of more or less imposing individual houses.

Furthermore, according to the inventory of precarious and substandard housing areas (ZHPI), drawn up for the 2006–2008 period and which is currently being updated, 103 substandard buildings have been identified in the Saint-Leu study area.

The town centre is home to a large number of local shops and services which contribute to the quality of life of its inhabitants. In the town centre of Saint-Leu, 30 facilities were identified in 2015 and these were mainly administrative.

Road and transport pressure

The district's street network is fairly dense and reflects its urbanization. Three main roads can be identified: rue du Général Lambert, rue Haute, chemin Dubuisson.

Several communal roads provide a more extensive network within the area and access to the various built-up areas of the town centre. There is also a large number of well organized parking areas, most of which are located along the main roads.

The organization of Saint-Leu's town centre offers a special place to pedestrians, who benefit from pavements and paths that are in good condition and adapted to the various soft modes of travel. The concentration of facilities, shops and services around rue du Général Lambert encourages soft mobility, as everything is quickly and effortlessly accessible within this central area. The presence of a pathway allowing for the crossing of the entire coastal border and which is particularly adapted to cyclists and pedestrians is to be noted. In addition, the northern and southern entrances to the town centre have cycle paths that allow people to reach Saint-Paul to the north and Etang-Salé to the south in complete safety. In terms of alternative mobility, the town centre of Saint-Leu is relatively well served by public transport. There are several bus lines that serve more than 25km.

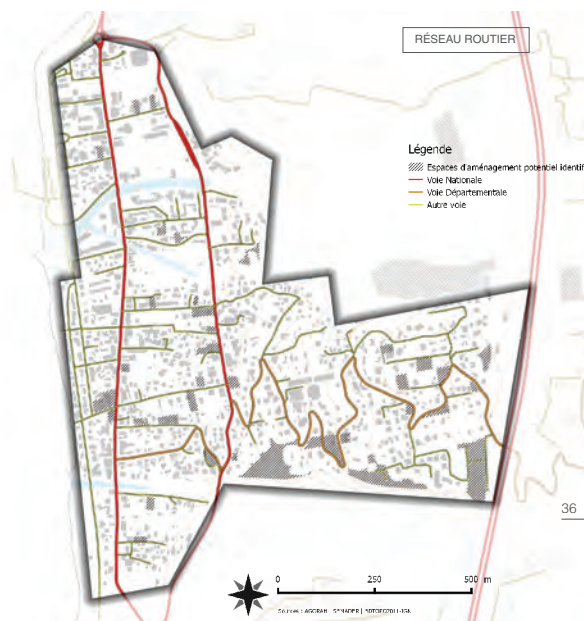
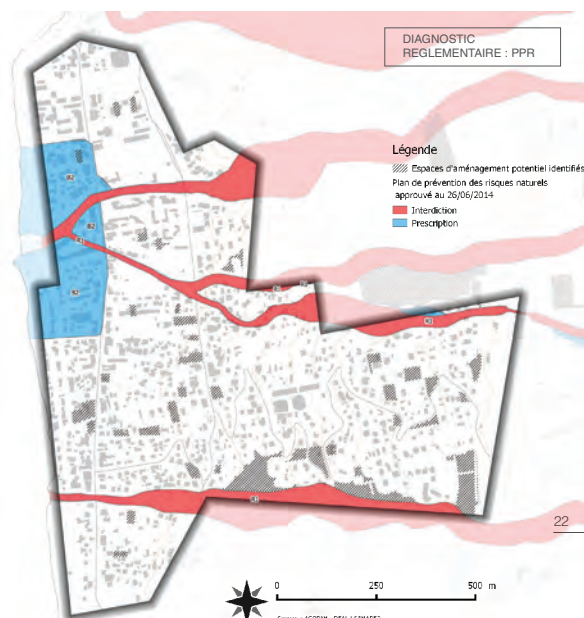
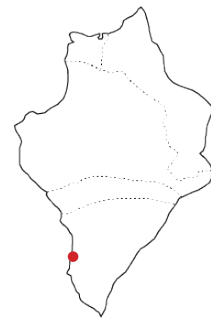


Photo of the bay of Saint-Leu, Cahier urbain, AGORAH

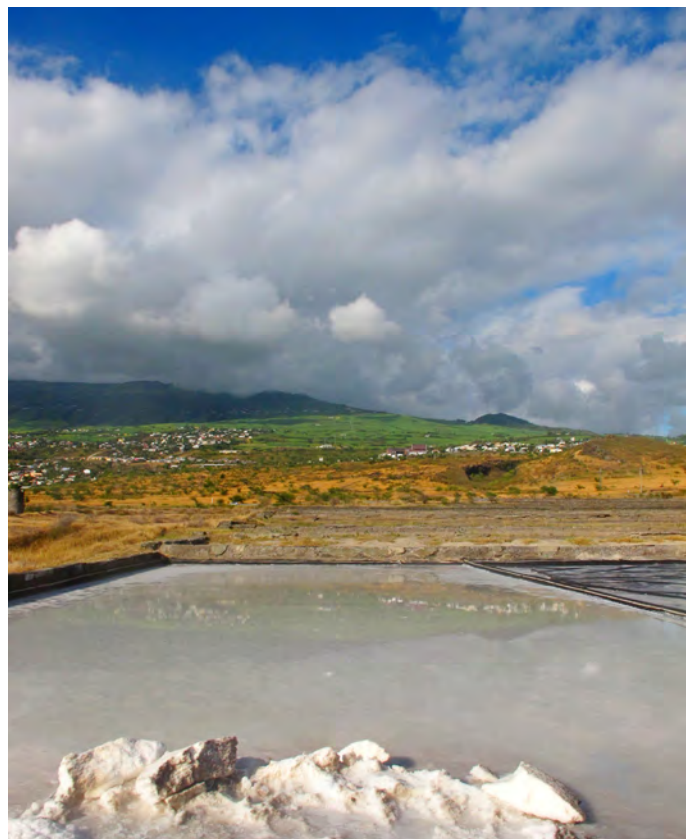
Cité des Pêcheurs (Fishermen's town) and its coastline⁵⁷



Location and physical environment

The study area has a heterogeneous topography due to the presence of a ravine. With this topography and the ravine, the site presents a high risk of flooding.

The Cité des Pêcheurs is heavily exposed to winds with a dominant east to southeast direction (trade winds). Day-time sea breezes (west to southwest) are fairly frequent, as are light summer winds (north to northeast). The area enjoys abundant sunshine with very mild temperatures reaching 25°C almost every day of the year. The average daily rainfall is low, but the intensity of the rain can be very high during tropical depressions or cyclonic episodes. This rainfall irregularity governs the dynamics of the ravines and has multiple consequences on the oceanic environment: turbidity of marine waters, health of biological communities, morphology of the barrier beach, input of pollutants. Finally, the area's exposure to cyclonic events is a major constraint in terms of the resistance of planned infrastructures to swells and violent winds. The Cité des Pêcheurs is home to a number of issues related to natural risks such as flooding, coastal submersion and receding coastlines.

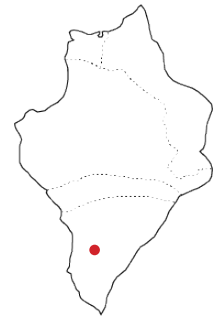


The saltworks of Saint-Leu, baladesreunionetailleurs



Skyview of Saint-Leu, cartedelareuni

The mid-slopes: A residential and agricultural cohabitation



Portail-Maduran is a district of the commune of Saint-Leu. This district, with its agricultural landscape and tranquil atmosphere, is home to 3,692 inhabitants who have an average age of 35, have moderate incomes, live mainly with their families, and mostly own their homes. The district has various services and infrastructures in its vicinity, including transport, commerce, health and

education. The ZAC Portail is directly accessible by the Tamarinds Road and therefore enjoys excellent accessibility. The ZAC is developing a large area, primarily for shops, which are particularly attractive. Managed and developed by CBO Territoria, it was created in 2012 for an area of 20.56 ha.



Zac Portail, CBO Territoria



Zac sans souci, SEMADER

III. Territories of interest

C. Along the water in Saint-Benoît

1. The CIREST in Réunion Island

The Communauté Intercommunale Réunion EST (CIREST) is an Établissement Public de Coopération Intercommunale (EPCI). It groups together 6 communes in the east of Réunion Island: Bras-Panon, Plaine des Palmistes, Saint-André, Saint-Benoît, Sainte-Rose and Salazie.

Formerly a Communauté de Communes (CCE), the CIREST became a Communauté d'Agglomération on 1 January 2002. The CIREST is the largest territory in Réunion. It covers 73,721 hectares or 29.3% of the island. Sixty percent of the national park is located within the CIREST territory. In 2020, the CA's jurisdiction was expanded: water and sanitation were transferred from the communes to the CIREST. It has nearly 127,500 inhabitants, i.e. 14.8% of the island's population.

On a regional scale

For the CIREST territory, the SAR establishes the fundamental guidelines for land-use planning and environmental protection and includes a special chapter, the Schéma de Mise en Valeur de la Mer (SMVM), which allows for the application of the Coastal Law.

The Eastern micro-region

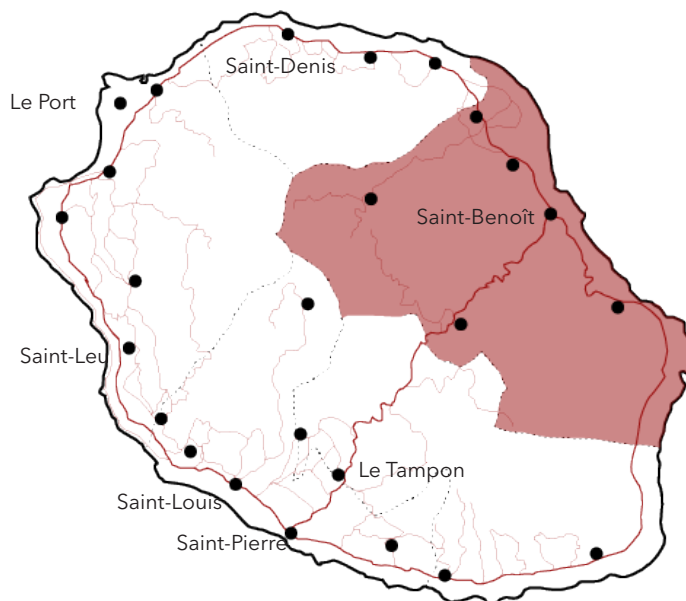
The Schéma de Cohérence Territoriale Est (SCOT Est) is a plan that sets out the main planning and development guidelines for the Eastern micro-region.

Produced by the CIREST, in close collaboration with external partners (State, Region, Department, etc.) and the elected representatives and departments of the six communes belonging to the Communauté d'Agglomération, the objective of the SCOT Est is to identify the preferential areas for the establishment of new neighbourhoods, new towns, areas for economic activities, tourist and leisure sites, structuring public facilities, etc. It organizes the layout of new roads and new modes of transport, delimits the cultivated land to be protected, the fallow areas to be reclaimed, as well as the forests and natural areas to be preserved. In summary, the SCOT provides answers to the challenges of tomorrow for the Eastern territory by:

-welcoming 60,000 more inhabitants in 2020 while preserving agricultural and natural areas;

-structuring the tourist offer by promoting the identity of the East through the development of the natural coastal areas and the highlands;

80 -boosting and diversifying economic activities, both



CIREST in La Réunion

complementary and non-competitive.

At the end of 2010, the SCOT was revised in order to comply with the requirements of the new SAR, which is currently being approved, but also to take into account the objectives of the Agglomeration Project, the Facilities projects and the TCSP.

On an inter-communal scale

The CIREST has launched its Territory Project – intended to structure the actions of the local authority – with the aim of outlining its ambitions and its territory. A Territory Project is a cross-cutting strategic planning document which includes a diagnosis, strategies and action plans concerning several fields of responsibility ranging from mobility to the environment and planning. Currently in the process of being drawn up, the CIREST Territory Project pledges to engage in actions:

- for an attractive, sustainable, innovative and job-creating economy;

- for an attractive, sustainable, innovative and job-creating economy;

- in favour of solidarity-based services for the quality of daily life for all; Biodiversity, Ecological and Energy Transition.

III. Territories of interest

C. Along the water in Saint-Benoît

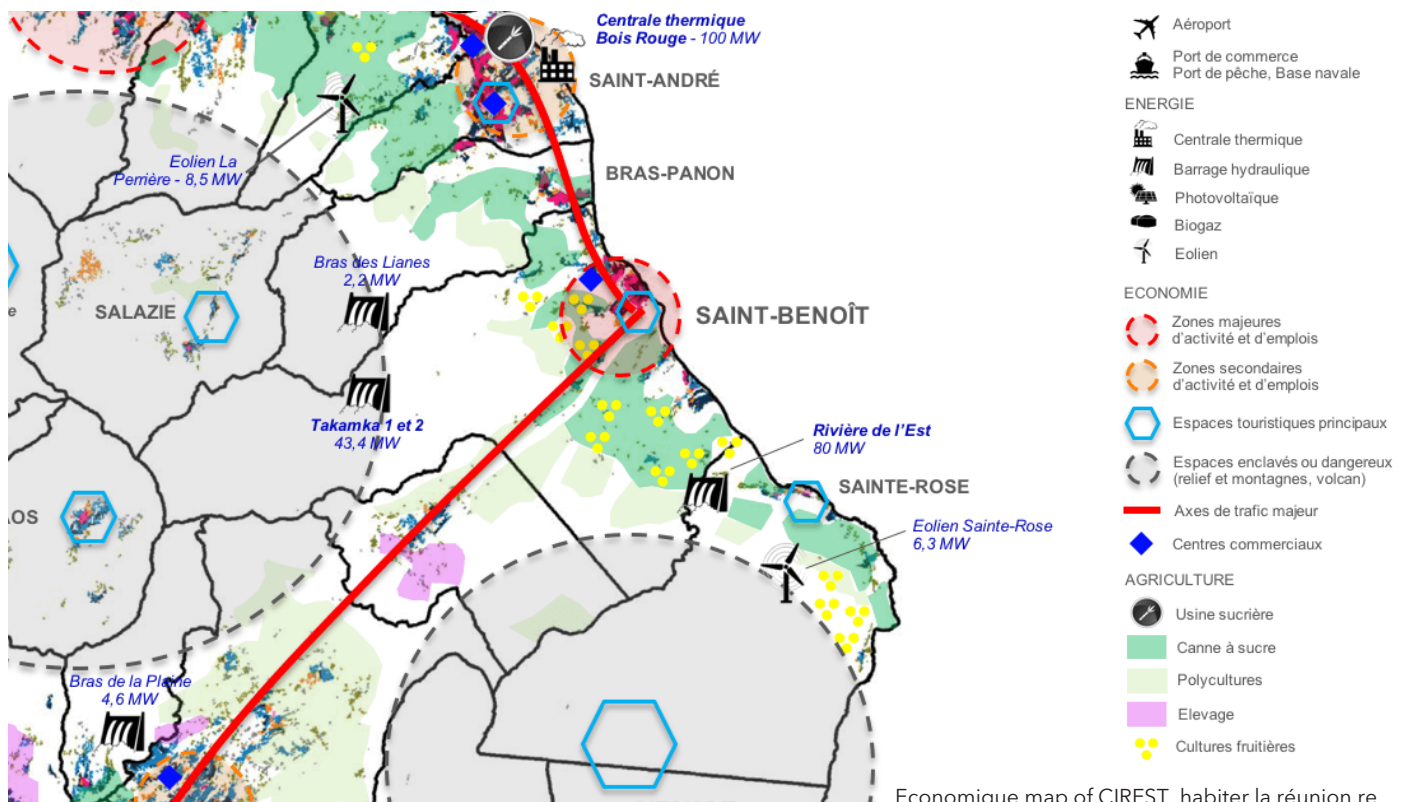
2. The CIREST in detail

The CIREST is located on the Côte au Vent. It has many riches within its territory, notably the Salazie cirque, the primary forest of Bébou and the Takamaka Valley. The sub-prefecture of Saint-Benoît is the second largest commune in the department. Although it is still essentially a rural territory, it has nevertheless developed in certain sectors. Long behind in terms of economic development, the CIREST can now boast the first and largest Inter-communal Urban Free Zone in France, thanks to its 3,000 dedicated hectares in the communes of Bras-Panon, Saint-André and Saint-Benoît. This free zone includes a timber cluster and an agri-food cluster, which consists of an exclusive 20-hectare park for the agri-food industry. Indeed, many fruits (litchis, pineapples, guava trees, etc.) are produced in the region. However, sugarcane fields still cover large areas on the coast and the mid-slopes of these communes, as well as in Bras-Panon and Sainte-Rose.

Furthermore, and with a strong focus on sustainable development since 2009, the CIREST, in partnership with the ARER, has carried out structuring actions for its energy strategy and the development of renewable energy. This commitment has taken the form of solar villages located in the east (Bras-Panons, Sainte-Rose, Bras de Chevrettes in Saint André, etc.).



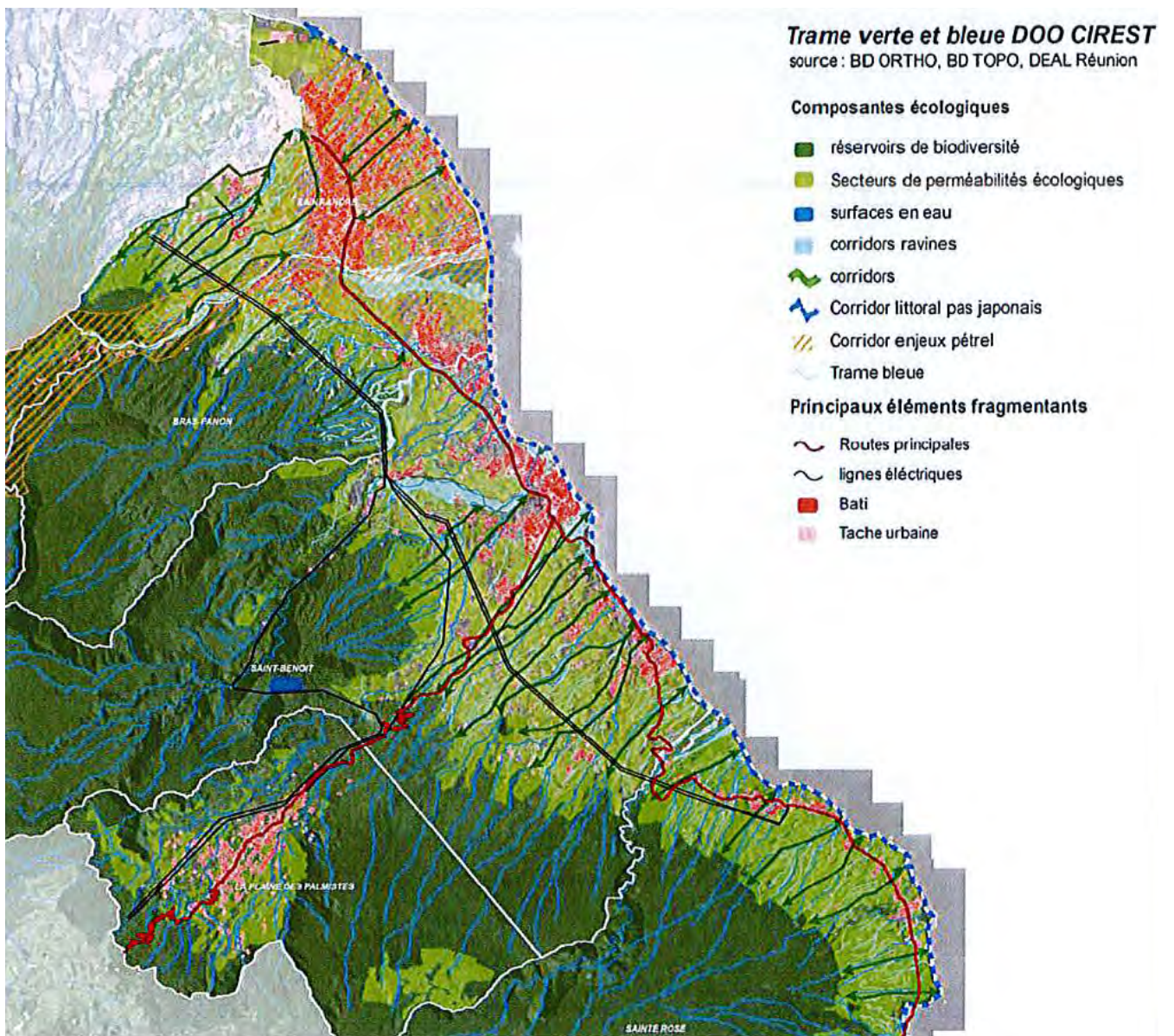
Communes of CIREST



Economique map of CIREST, habiter la réunion.re



CIREStmapping, CIREST

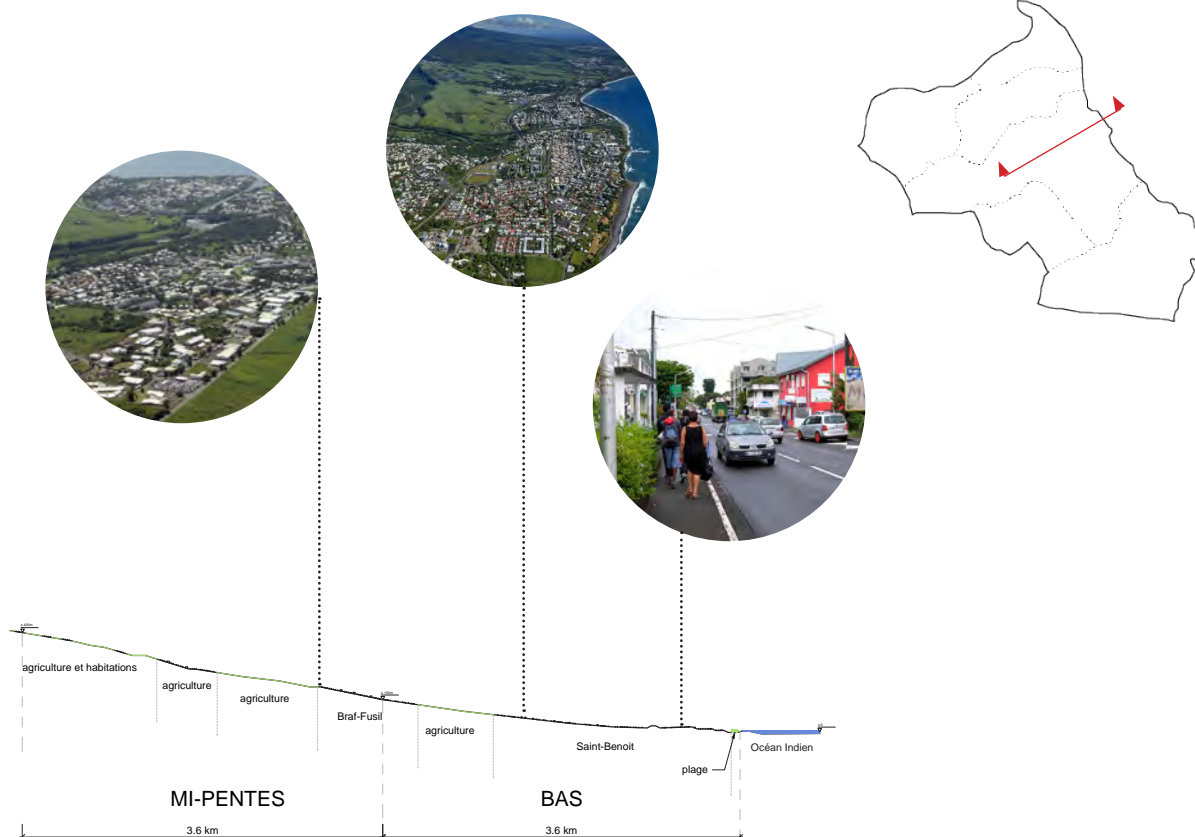


Green and blue frame of the CIREST, BD ORTHO, BD TOPO, DEAL

III. Territories of interest

C. Along the water in Saint-Benoît

3. Territorial section : Along the water in Saint-Benoît



Photography: ville de Saint-Benoît



Saint-Benoît: "City of Nature and Flowing Water"⁵⁸⁵⁹



Population

The commune of Saint-Benoît as a whole presents particularly unfavourable social indicators compared to the averages for Réunion, with the Rive Droite-Beaufonds district being particularly illustrative in this respect. The population is characterized by a slight increase in demographic growth, although 44% of the inhabitants are under 25 years of age, with a high proportion of single-parent families (30%) and single people (24%). The unemployment rate is 46.5%, above the departmental average; 56.6% in the Beaufonds sector. Unique to Réunion, the rate of motorization is low, with 49% of inhabitants without a vehicle.

The social housing stock represents 43.7% of primary residences. Few new social housing units have been built in this district in recent years, as private developments are almost non-existent. The private housing sector corresponds to individual housing of the "hut on the ground" type. Mainly built on small plots of land, most of them require improvement work. There are diffuse pockets of substandard housing, mainly on the seafront (Beaufonds), within the municipal average, estimated at around 8%. The vacancy rate is relatively low due to the tightness of the housing market and the large number of applicants on the waiting list.

Economic activity

Economic activities are concentrated along the main traffic route, which traverses the district from east to west (Bd Jean Jaures) and links it to the city centre by a single structure crossing the Marsouins River. The economic sector is not very dynamic nor dense, consisting of a few local shops and two supermarkets at the western end of the district. A commercial wasteland with a significant surface area is located along the main axis. Partly demolished today, it has been replaced by an apartment building (Baobab 1) that was completed in 2017. With the exception of the main axis, which was initially intended to accommodate the future TCSP, most of the internal road network is made up of narrow alleys, often one-way, which do not facilitate access to the district by public transport. Most of the roads do not have any space for pedestrians. The only major facilities of note are the Bambous Theatre, the MJC, nursery and primary schools, two high schools that are not well integrated into the district, and their corresponding sports facilities. There is a lack of health care facilities, as well as a limited number of public spaces, with those that are present poorly maintained and often cluttered with litter.



Station service d'entrée de ville



Église de Saint-Benoît



Hôtel de ville de Saint-Benoît



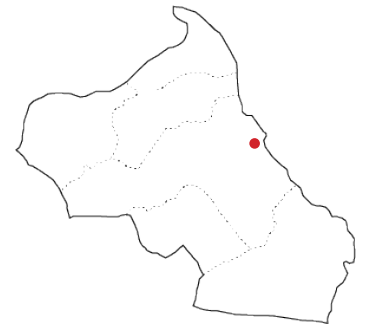
Ancien cinéma



LA FABRIQUE URBAINE - AGENCE TER - CP&O - TERRIDEV - INGETEC



Saint-Benoît and Beaufonds: Urban experimentation⁶⁰



The Commune of Saint-Benoît is committed to a vast urban renewal project on its right bank (Labourdonnais-Beaufonds districts), which has been identified as a district of national interest under the New National Urban Renewal Programme (NPNRU). As such, a preliminary protocol was signed in June 2016 with the ANRU and its partners in order to finance several studies that led to the signing of an urban renewal agreement in March 2020.

Within the Communauté Intercommunale de La Réunion EST (CIREST), Saint-Benoît is positioned as the geographical heart of the Eastern micro-region. In this context, Labourdonnais-Beaufonds, the subject of the present NPNRU, offers a rare and valuable context in Réunion. The district is located opposite the city centre of Saint-Benoît, south of the Marsouins River. It constitutes a large sector of approximately 165 hectares and 7,116 inhabitants, i.e. a relatively low gross density of 18 housing units per hectare.

It is also a continuation of a first generation urban project (the PRU de Bras Fusil) to the north of the RN3 and therefore must deal with the ongoing dynamics initiated by the project. From the start of the AMI ADEME support, the scale of the NPNRU has focused on the town centre of Saint-Benoît (right bank) and its revitalization as a City of Nature and Flowing Water in the heart of the eastern coast of Réunion.

A partnership project to transform a city centre marked by its urban and social characteristics

The project is intended to consolidate a 20-year urban vision within a 7-year NPNRU operational plan. Following the diagnosis of the NPNRU, three strategic areas of intervention for the urban project were defined and spatially translated by the group responsible for the urban project:

- An expansion of the city centre on both sides of the Marsouins River;
- A reclaiming of the fringes (banks of the Marsouins River, the agricultural fringes and the heritage of the former Beaufonds sugar cane factory, and the arrival of a TCSP on the RN2);
- The improvement of the daily living environment: a walkable city centre, outdoor spaces to be developed and a land potential to be mobilized towards urban and local agriculture.



ZAC Beaufonds, PLU de Saint-Benoît



The 15-20 year master plan follows a dual strategy:

1. A proactive strategy: public facilities, housing, major public spaces
2. A patient strategy: "working with resources" to improve the living environment

A proactive circular economy approach

The circular economy project calls for a form of urban renewal based on 4 programme axes interconnected in an overall logic and flow loop.

- A reflection on a programme of kitchen gardens in the sector of the former Beaufonds factory.
- Consideration of a restaurant and the sale of local food products around the Labourdonnais centre (proximity of medium-sized stores, an open-air market and a covered market, and a leisure offer on both sides of the river).
- A reflection on a polarity allowing for the networking of SSE actors and a link between the Cité scolaire and the Bras Fusil district.

- A tactical urban planning approach, and the development of local shared gardens and pre-greening spaces on the numerous brownfield sites and urban wastelands.

Starting with food flows

Numerous exchanges with stakeholders, initiated during the NPNRU project consultation and continued during the ADEME AMI, have focused on the advantages of relocating food flows. Consideration is being given to a programme of kitchen gardens in the sector of the former Beaufonds factory: this structure could produce fruit and vegetables consumed in canteens or sold to households in the area. It could also contribute to the job integration process and to the development of skills in market gardening, gardening and the maintenance of planted areas.



PLU de Saint-Benoît

The Zac Bras Madeleine: The link between the Bas and Mi-pentes⁶¹



The SEMAC has been managing the ZAC Madeleine development project since 2002, through a development concession contracted with the municipality of Saint-Benoît. The ZAC Madeleine covers an area of approximately 30 hectares located to the south of the town centre of Saint-Benoît, in the extension of the "old" Bras Fusil district. It is bounded by Route Nationale 3 to the south, Ravine Bras-Canot to the north, the rainwater interceptor built in 2001 to protect the Bras-Fusil sector from flooding to the west, and the former Bras-Fusil neighbourhood to the east, which has now been completely renovated as part of the ANRU operation "Bras-Fusil, Better Living Together".

The general aim of the project is to promote a "piece of the city" underpinned by several objectives such as meeting the equipment needs of the district, the city and even the Eastern micro-region; meeting housing needs (including 70% social housing); and developing the Bras-Fusil district by linking the lower city to its upper extensions.

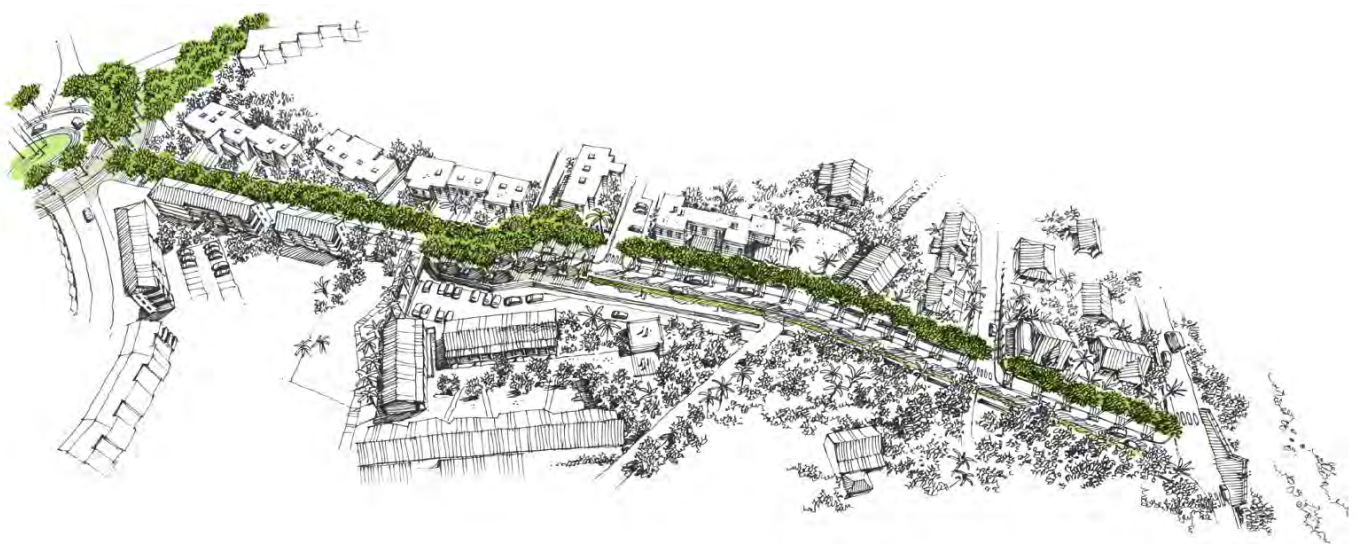


Bras-Fusil et Saint-Benoît en 1950.
(IGN 1950 - acquisition Parc national de La Réunion)

La même chose en 2008.
(BDOrtho, IGN, 1997 - 2008)



Bras-Fusil, Forum inter régional des acteurs de la rénovation urbaine



Bibliography

ADEME, Vers l'autonomie énergétique en Zone Interconnectée (ZNI) à l'horizon 2030, 2018

ADEME, Saint-Benoît, ville de nature et d'eaux vives

Agence Folléa-Gautier pour DEAL / Ministère de l'Ecologie, Les paysages et les climats, Atlas des paysages de La Réunion,

Agorah, Les productions de l'agence d'urbanisme à La Réunion

Carpanin Marimoutou, Professeur à l'université de La Réunion, chargé de mission sur le projet de la Maison des civilisations

et de l'unité réunionnaise (MCUR)

CAUE et DEAL de la Réunion, livret de la densité et qualité urbaine

Chalancon Elodie, Les possibilités d'une densification verticale à l'île de la Réunion : de la kaz atèr à la kaz atèr anlèr, 2015

CIRAD Étude sur les freins et leviers à l'autosuffisance alimentaire : vers de nouveaux modèles agricoles dans les départements et régions d'outre-mer. Jacques Marzin, Sandrine Fréguin, Nadine Andrieu, Valentina Bano Claire Cerdan, Joël Huat, Benoit Daviron et Valérie Angeon,

Combeau Yvan, De Bourbon à La Réunion, L'histoire d'une île (du XVIIe au XXe siècle), Centre de Recherches sur les Sociétés de l'océan Indien, Université de La Réunion

CRDP de La Réunion, Cases créoles de La Réunion

Dalama, Marie-Gisèle. « L'île de la Réunion et le tourisme : d'une île de la désunion à la Réunion des Hauts et Bas », L'Espace géographique, vol. 34, no. 4, 2005, pp. 342-349.

Folio Fabrice, « Réalités et singularités du tourisme réunionnais : entre utopie et motifs d'espoir », Les Cahiers d'Outre-Mer, 245 | 2009, 7-33.

Gros-Désormeaux Jean-Raphaël , « La biodiversité dans des territoires insulaires, approche théorique et perspectives de développement », Développement durable et territoires [En ligne], Vol. 3, n° 1 | Mai 2012, mis en ligne le 24 mai 2012, consulté le 12 septembre 2021

JAUZE, Jean Michel, Dynamiques urbaines au sein d'une économie sucrière: le cas de la région Est Nord-Est de la Réunion. Paris, L'Harmattan, 1997

Labache Lucette, l'ethnicité chez les réunionnais en migration

LORION, David. L'eau, pilier du développement durable en milieu insulaire : L'exemple de l'île de la Réunion In : Insularité et développement durable [en ligne]. Marseille : IRD Éditions, 2011

Micro-poros, Agence d'urbanisme d'agglomération de Tours, D'Arienzo R., Younès, C., Lapenna A., Rollot M., "Ressources urbaines latentes, pour un renouveau écologique des territoires", Metispresss, vues D'ensemble Essais, 2016

Mimura, N., L. Nurse, R.F. McLean, J. Agard, L. Briguglio, P. Lefale, R. Payet et G. Sem, 2007, "Small islands" in M.L. Parry, O.F. Canziani, J.P. Palutikof, P.J. van der Linden and C.E. Hanson, réd., Climate Change 2007: Impacts, Adaptation and Vulnerability. Contribution of Working Group II to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change. Cambridge : University Press, chapitre 16

Nexa, Le livre vert du bâti tropical à La Réunion, 2018

ONERC, Rapport de l'Observatoire National sur les Effets du Réchauffement Climatique de 2004

Pourchez Laurence, Volume 38, Issue 2, Le métis comme catégorie sociale, 2014

Roinsard Nicolas, Soixante ans de départementalisation à La Réunion : une sociologie des mutations de l'organisation sociale et de la structure de classe en contexte postcolonial, 2012

TOSSEM Aurélie, Les cirques de La Réunion, un territoire touristique en devenir : questionnements et enjeux, 2016

Website

ADEME.fr

AGORAH.com

atlasdespaysages-lareunion.re

BRGM.fr

CAUE974.com

CIREST.fr

CIVIS.fr

conservatoire-du-littoral.fr

diplomatie.gouv

ecologie.gouv.fr

IEDOM.fr

INSEE.fr

la1ere.francetvinfo.fr

ONF.fr

ouest-lareunion.com

reunion.fr

reunion.developpement-durable.gouv.fr

Saint-benoit.re

Saintleu.re

Saintlouis.re

SMEP Grand Sud.re

TCO.re

Endnotes

- 1 Connaissance géologique de La Réunion, livret de l'enseignant, Pierre Mehlig et Marie Bucelle, BRGM éditions, 2005
- 2 Atlas des paysages de La Réunion, Agence Folléa-Gautier pour DEAL / Ministère de l'Ecologie, consultable sur internet : <http://www.atlasdespaysages-lareunion.re/>
- 3 Les paysages et les climats, Atlas des paysages de La Réunion, Agence Folléa-Gautier pour DEAL / Ministère de l'Ecologie, consultable sur internet : http://www.atlasdespaysages-lareunion.re/page1.php?id_chapitre=113
- 4 De Bourbon à La Réunion, L'histoire d'une île (du XVIIe au XXe siècle), Yvan Combeau, Centre de Recherches sur les Sociétés de l'océan Indien, Université de La Réunion
- 5 Insularity and sustainable development, Dir. TAGLIONI François, IRD, 2011
- 6 IEDOM, Overseas France Index (Tableau de bord des Outre-mer), 2018
- 7 Roinsard Nicolas, Soixante ans de départementalisation à La Réunion : une sociologie des mutations de l'organisation sociale et de la structure de classe en contexte postcolonial, 2012
- 8 IEDOM, La Réunion 2016, Édition 2017
- 9 INSEE, Statistics: Living standards and poverty, 2017
- 10 INSEE, Migration statistics between Réunion and mainland France, 2017
- 11 Labache Lucette, L'ethnicité chez les réunionnais en migration, 2002
- 12 Global Footprint Network, Biocapacity, 2018.
- 13 European funds for Réunion Island 2014-2020
- 14 ONERC, 2004
- 15 French Ministry of Foreign Affairs, France and the Indian Ocean Commission, 2021
- 16 French Ministry of Foreign Affairs, Bilateral relations with Mauritius, 2021
- 17 French Ministry of Foreign Affairs, Bilateral relations with Mauritius, 2021
- 18 Carpanin Marimoutou, professor at the University of Réunion and head of the Maison des civilisations et de l'unité réunionnaise (MCUR) project.
- 19 Pourchez Laurence, Volume 38, Issue 2, Le métis comme catégorie sociale, 2014
- 20 CRDP of Réunion, Creole houses of Réunion
- 21 The Director of the Environment, Planning and Housing, Handbook on density and urban quality
- 22 Réunion CAUE and DEAL, Handbook on density and urban quality
- 23 Réunion CAUE and DEAL, Handbook on density and urban quality
- 24 INSEE, population census 2020
- 25 JAUZE, Jean Michel, Dynamiques urbaines au sein d'une économie sucrière: le cas de la région Est Nord-Est de la Réunion. Paris, L'Harmattan, 1997
- 26 INSEE, Flash Réunion n°89, 2017
- 27 Mimura, N., L. Nurse, R.F. McLean, J. Agard, L. Briguglio, P. Lefale, R. Payet et G. Sem, 2007, "Small islands" in M.L. Parry, O.F. Canziani, J.P. Palutikof, P.J. van der Linden and C.E. Hanson, ed., Climate Change 2007: Impacts, Adaptation and Vulnerability. Contribution of Working Group II to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change. Cambridge: University Press, Chapter 16.
- 28 Bastone V, and De La Torre Y., Etude préliminaire de l'impact du changement climatique sur les risques naturels à la Réunion. Rapport public du BRGM, August 2011.
- 29 Jean-Raphaël Gros-Désormeaux, "La biodiversité dans des territoires insulaires, approche théorique et perspectives de développement", Développement durable et territoires [Online], Vol. 3, n° 1 | May 2012, online 24 May 2012, accessed 12 September 2021.
- 30 Thérésien Cadet, La végétation de l'île de La Réunion, étude phytoécologique et phytosociologique, 1977 Doctorat ès Sciences. Aix-Marseille III, Aix-en-Provence
- 31 LORION, David. L'eau, pilier du développement durable en milieu insulaire : L'exemple de l'île de la Réunion In: Insularité et développement durable [online]. Marseille: IRD Éditions, 2011 (generated on 18 September 2021).
- 32 Agorah, Bilan des Observatoires, 2017
- 33 Micro-poros, Agence d'urbanisme d'agglomération de Tours, D'Arienzo R., Younès, C., Lapenna A., Rollot M., "Ressources urbaines latentes, pour un renouveau écologique des territoires", Metispress, vues D'ensemble Essais, 2016
- 34 Autorité de la concurrence
- 35 Nexa, The green book of tropical building in Réunion, 2018
- 36 INSEE
- 37 2018 Data from the Waste Observatory of Réunion Island
- 38 2016 Data from the Waste Observatory of Réunion Island
- 39 Réunion CAUE and DEAL, Handbook on density and urban quality
- 40 Étude sur les freins et leviers à l'autosuffisance alimentaire : vers de nouveaux modèles agricoles dans les départements et régions d'outre-mer. Jacques Marzin, Sandrine Fréguin, Nadine Andrieu, Valentina Bano Claire Cerdan, Joël Huat, Benoit Daviron and Valérie Angeon, CIRAD.
- 41 Agreste La Réunion, Memento 2020, Ministry of Agriculture and Food
- 42 Caroline Méjean, Alimentation et nutrition dans les départements et régions d'Outre-mer (Food and nutrition in the French overseas departments and regions), IRD Editions, 2020.
- 43 ADEME, "Towards energy autonomy in Non-Interconnected Zones (ZNI) by 2030", 2018
- 44 ODI France report, 2008
- 45 Aurélie TOSSEM, Les cirques de La Réunion, un territoire touristique en devenir : questionnements et enjeux, 2016
- 46 SMEP Grand Sud.re
- 47 INSEE
- 48 reunion.orange
- 49 Cahier Urbain, AGORAH
- 50 Cahier Urbain, AGORAH
- 51 At the regional level, there are 5.4 facilities/1,000 inhabitants.
- 52 INSEE figures as of 1 January 2021, following the 2018 census and the annual sample surveys
- 53 ONF
- 54 TCO.re
- 55 TCO.re
- 56 Cahier urbain, AGORAH
- 57 mi-aime-a-ou.com
- 58 File updated on 30 November 2017 by Francis EHRHART, DEAL, SHLS, in charge of the ANRU North and East sectors
- 59 ADEME, Saint-Benoît: City of Nature and Flowing Water
- 60 ADEME, Saint-Benoît: City of Nature and Flowing Water
- 61 Saint-Benoît.re
- 62 Connaissance géologique de La Réunion, livret de l'enseignant, Pierre Mehlig et Marie Bucelle, BRGM éditions, 2005
- 63 Atlas des paysages de La Réunion, Agence Folléa-Gautier pour DEAL / Ministère de l'Ecologie, consultable sur internet : <http://www.atlasdespaysages-lareunion.re/>
- 64 Les paysages et les climats, Atlas des paysages de La Réunion, Agence Folléa-Gautier pour DEAL / Ministère de l'Ecologie, consultable sur internet : http://www.atlasdespaysages-lareunion.re/page1.php?id_chapitre=113
- 65 De Bourbon à La Réunion, L'histoire d'une île (du XVIIe au XXe siècle), Yvan Combeau, Centre de Recherches sur les Sociétés de l'océan Indien, Université de La Réunion

Les Ateliers would like to acknowledge the following persons for providing invaluable guidance, stimulating discussions and continuous support during the writing of this document:

Cédric Vautier (Agence Française de Développement)

Frederic Leble (Agence Française de Développement à La Réunion)

Emmanuelle Schatz (Agence Française de Développement)

Mélanie Molin (DEAL)

Thomas Dedenon (DEAL)

Anthony Rasolohery (Région Réunion)

Caroline Wolf (Région Réunion)

Maëlle Nicault (Région Réunion)

Karelle Vaudour (Département Réunion)

Bruno Anantharaman (Département Réunion)

Jean-Louis Maillot (CIVIS)

Stéphane Babonneau (CIVIS)

Stéphanie Laporte (Saint-Louis)

Les services de la ville de Saint-Louis

Sébastien Hermann (CIVIS)

Benoit Pribat (Agorah)

Claudie Daly (TCO)

Aurélie Rivière (TCO)

Cindy Moutoucomarapoulé (Saint-Leu)

Les services de la ville de Saint-Leu

Natacha Bosse (CIREST)

Anita Razafindrasoa (CIREST)

Ning Liu

Christophe Bayle

Jean Grébert

