International urban planning workshop

Adapting island territories to climate change
Reunion Island: Actions for island resilience

From September 25 to October 8, 2021

CONTEXT DOCUMENT

Appendices

Texts written by Simon Brochard (Island Voices), Julie Smeyers (Indian Ocean territories) and Justine Goudet (round tables).

Translation by Susanna Hsing (Island Voices and round tables), and Marcelus Siqueira (Indian Ocean Territories)

With the support of

Island Territories Workshop – Réunion Island

Adapting island territories to climate change

Island Voices

Summaries and synthesis

A series of video-conference debates to identify the challenges of climate change for island territories, and to create a dialogue between the different island entities by shedding light on their various commonalities and differences.

Food security: Autonomy and dependence of island territories
How to achieve the energy transition and break through the isolation of island territories?
Coastal development: Between ecological preservation and economic attractiveness

Les Ateliers de Cergy is a non-profit association created in 1982 at the initiative of the urban planners of the New Town of Cergy-Pontoise. Today, it is an international network of professionals, academics and decision-makers in urban planning. Focused on the practice of urban project management, the association organizes workshops conceived as spaces for collective design and creativity.
In France and abroad, these workshops provide project managers with an international perspective and illustrated proposals for territorial strategies and urban development projects. Through the convergence of different professions and cultures, they also serve to question learning processes and exchange at the highest level.
At the initiative of the French Development Agency, the association is leading the Island Territories programme with a series of events and discussions aimed at developing urban proposals that take into account the specific challenges faced by island territories in the context of climate change. This effort will culminate in the organization of an international urban planning workshop on Réunion Island, a pivotal workshop that will bring together professionals from all over the world in 2021 to engage in a collective production and exchange.
Island Voices was a series of online discussions and debates launched in 2020 to explore the issues affecting island territories in the light of climate change. This series was prepared by the Strategic Steering Committee of the Island Territories workshops. This document presents the summaries of these events and their synthesis.

Strategic Steering Committee of the Island Territories workshops:
Florence Bougnoux, member of Les Ateliers Board of Directors, architect–urban planner
Simon Brochard, workshop assistant–coordinator, geographer and historian
Barbara Chénot, Réunion Island workshop co-pilot, engineer and urban planner
Frédéric Fourreau, Réunion Island workshop co-pilot, landscape architect and editor
Jean Grébert, Indian Ocean workshop pilot, member of Les Ateliers Board of Directors, mobility expert
Michel Jaouën, Vice president of Les Ateliers, architect–urban planner
Christine Lepoittevin, Director of Les Ateliers, sociologist
Sébastian Miguel, architect–urban planner
Laurent Perrin, member of the Scientific Steering Committee, architect–urban planner
Véronique Valenzuela, Director of projects at Les Ateliers, geographer

Translation : Susanna Hsing, September 2021

Island voices: A synthesis

Food security: Autonomy and dependence of island territories

7 July 2020, 3:30pm–5pm (GMT +2)

Session moderated by Jean Grébert, Head of Mobility Systems at the IMD Institute for Sustainable Mobility Renault-ParisTech Foundation, member of Les Ateliers Board of Directors

The crisis linked to COVID-19 and the curtailment of international travel has exposed the dependence of island territories on the outside world. How has this crisis revealed or highlighted situations of dependence and food insecurity? What changes are taking place on the islands in terms of agricultural policy, agro-ecology and land-use planning? Can the establishment of archipelagic systems constitute a sustainable response to the challenges of food security for islands?

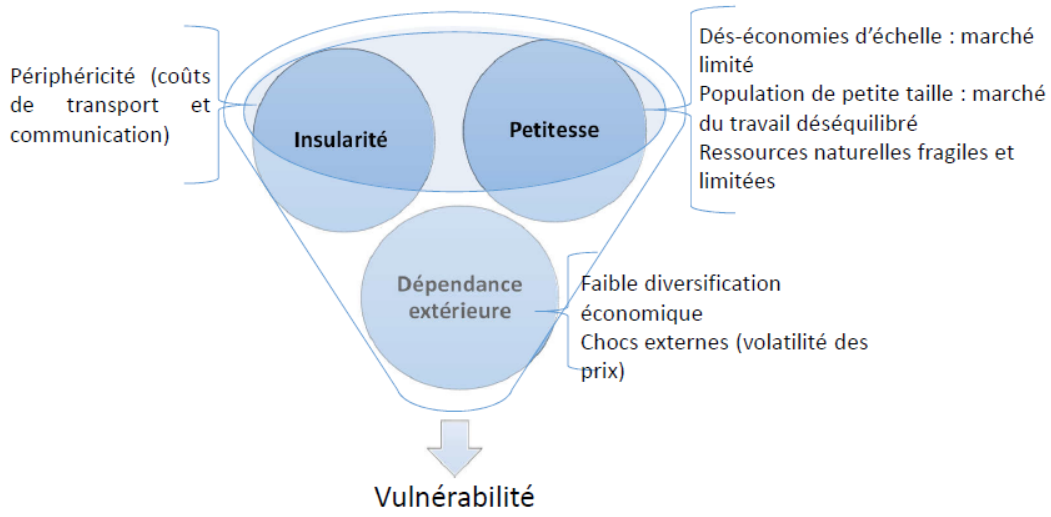
- *What levels of vulnerability and food-related risks can be identified in island territories? What weaknesses has the COVID crisis revealed?*
- *What are the determining factors for building food security? Environmental factors and climate change; production; marketing; distribution and infrastructure; social, land and resource factors; etc.*
- *How can resilience be built or rebuilt over time? What is the role of innovation, good practices, new actors, links with other fields (energy, waste, tourism, etc.) and the role of the regional environment?*

Guest speakers:
Claire Cerdan, geographer, Centre de Coopération Internationale en Recherche Agronomique pour le Développement (CIRAD) – Réunion Island
Valérie Angeon, economist, Institut National en Recherche en Agriculture, Alimentation et Environnement (INRAE) – Guadeloupe
Sandrine Fréguin-Gresh, economist and geographer, Centre de Coopération Internationale en Recherche Agronomique pour le Développement (CIRAD) – Caribbean region

Vulnerabilities of island territories

The notion of "small island economies" first truly appeared as a category of analysis and a statistical unit recognized by the UN and the World Bank in the 2000s, through the creation of the Small Island Developing States (SIDS). These islands joined forces to highlight the particularities and difficulties associated with their insularity. Due to their remoteness and isolation, small island economies have to cope with high production, transport and infrastructure costs. They have to deal with the restricted size of their domestic market: it is difficult to set up large-scale production, especially as natural resources are limited. These small populations are also experiencing an exodus of skills to the outside world. Isolation and limited markets lead to conditions of external dependence and a low level of economic diversification, which makes these economies structurally vulnerable as outside partners dictate their prices.
It should be noted that the SIDS are a separate category from the European Union's Ultra Peripheral Regions (UPRs), which include Réunion, Martinique and the Azores, but they share many of the same challenges. The UPRs generally have an even stronger import dynamic and dependence on the outside world, with significant income flows. Often, the population density is quite high on these islands and the physical space is saturated. This leads to competition for space for new activities. All these factors lead to a situation of precariousness and food insecurity that is found on many islands. Tourist island territories also have the particularity of being vulnerable to unintentionally invited bio-

aggressors, some of which do not have effective native competitors to protect their local agricultural production.
In many cases, agricultural policy choices, specialization and single-crop farming in conventional agriculture have also left family farming and diversified agriculture (which can be resilience factors in the island economy) in the minority and nearly invisible.
On Réunion Island, for example, the production of local food is still seen as less economically crucial, but rather as an element of diversification. The way in which export and local agricultural sectors can coexist remains an important issue.
Another challenge lies in the fact that agricultural populations are ageing: who will take over for them? And who will be able to continue to transmit their knowledge and know-how as well?



Vulnerabilities of island territories (© Valérie Angeon)

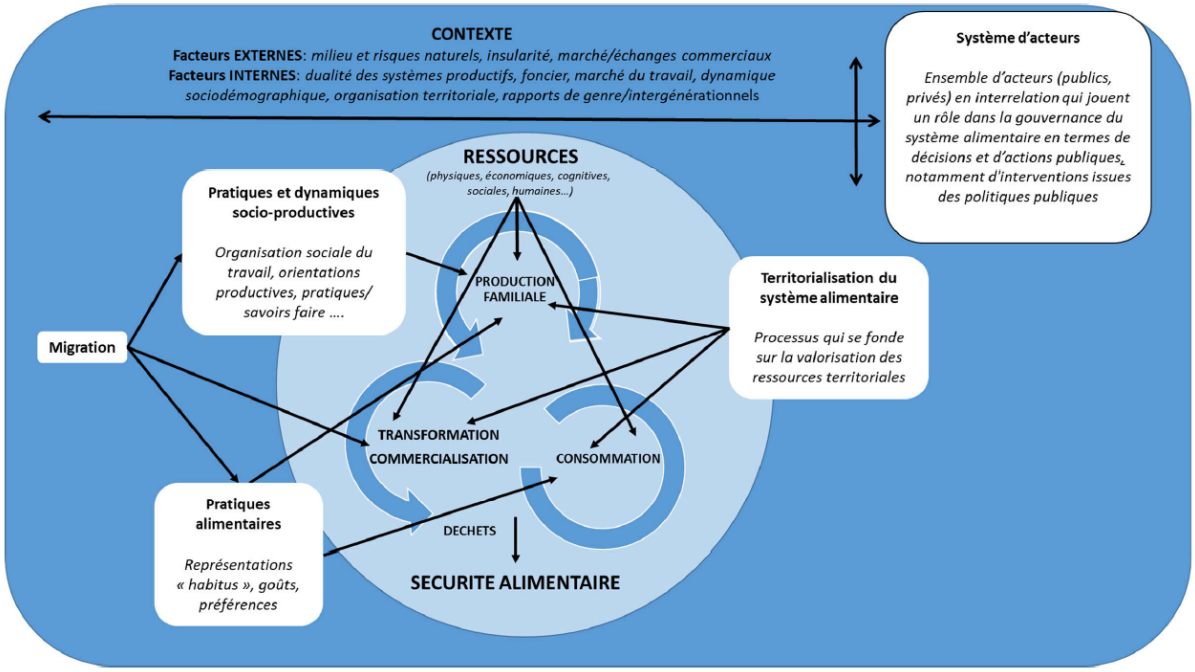
Impact of COVID and lockdown measures on the already vulnerable territories of Réunion and Mauritius

Réunion: The isolation periods and travel restrictions associated with COVID have had a major impact on the food system in Réunion, despite the fact that the island has fared relatively well in its own right. The closure of ports and airports has affected animal feed and supply stocks, which are often imported. Some products have seen their prices rise (onions, garlic, etc.). A number of cooperatives that mainly sell directly to restaurants have been severely handicapped. In Réunion, as in Mauritius, the agro-industry has suffered from surpluses of pineapples produced for export. On the other hand, the cattle and produce (fruit and vegetables) sectors have managed to adapt to the situation: the closure of the ports has blocked imports and thus enabled local agriculture to be further developed.
Mauritius: Mauritius imports 75% of its foodstuffs such as rice, flour, grains and fruit, so the situation has been difficult with many stalls remaining empty. However, a self-sufficiency in terms of vegetables exists. Access, availability, quality and sustainability are important elements that are currently being reflected upon, with actions also being put in place. The closure of borders has created a great challenge and a change in the way people consume. It has now become clear that it is important to produce and consume locally, as well as to reduce imports. As a result, a "Made in Mauritius" offering, which also corresponds to consumer demand, has been developed. Producers must therefore evolve, and the consumption of products such as breadfruit, sweet potatoes and taro encouraged.

Food security is multifactorial

Food security exists when all people have the physical, social and economic ability to secure sufficient, safe and nutritious food to meet their dietary needs and food preferences. This definition from the International Food Summit (1996) divides food into four dimensions: access, availability, quality of food and stability of access capacity (price/purchasing power).

In Guadeloupe, more than half of the population is experiencing food insecurity and dissatisfaction. Ms Fréguin-Gresh conducted a study on the determining factors of food security, based on the situation of Haitian migrants in Guadeloupe. She exposed the significant interdependence that exists between the economic, environmental and social dimensions of food. The difficulty of migrants to have sufficient food is based in particular on their difficult access to social and productive policies, their legal status and the formality of their activity, as well as the general perception of Haitians on the island. Certain resources such as social capital and access to natural resources are also crucial. Agriculture, even when developed in an informal setting, generates non-commercial exchanges and resilience to climatic shocks and price variability.
In the end, whether it concerns students, retirees or migrants, circulation is an essential strategic element for achieving security. Circulation between islands not only applies to people, but also knowledge, food and innovations; and it contributes to the construction of more resilient systems.



Food security is the result of a multifactorial game (© Sandrine Fréguin-Gresh)

Levers for achieving resilience

- **Supporting small-scale family farming**

Small agricultural entities are not recognized because they are not formalized; nonetheless, they play a structuring role in the food supply chain. These micro units often go unnoticed. As they are not considered administrative categories in current agricultural policies, they are not eligible for government support. Nevertheless, small family farms (such as backyard farming) are multi-performing entities, especially if we accept that they are agro-diverse, have an impact on soil quality, value local products with a strong identity, allow for non-commercial exchanges (which are often not accounted for), etc. Small family farms are certainly not paid for all the services they provide. But new indicators can help to identify these services. It is also important to bear in mind that the profitability of large farms is tied to a conventional agricultural model which is highly subsidized.

- **Agroecology**

Agroecology aims to make maximum use of nature as a production factor by maintaining its capacity for renewal. The aim is to preserve natural resources and reduce pressure on the environment. Agroecology offers a glimpse of agricultural models whose objectives are not to increase yields but rather to increase resilience: with agroecology, a hurricane should not be able to destroy an entire harvest. The example of the "zero waste" Gudie Leisure farm in Kampala is enlightening in this respect: a variety of activities are linked together, with food and animal waste being recycled into bioethanol or other products, all in one farm!

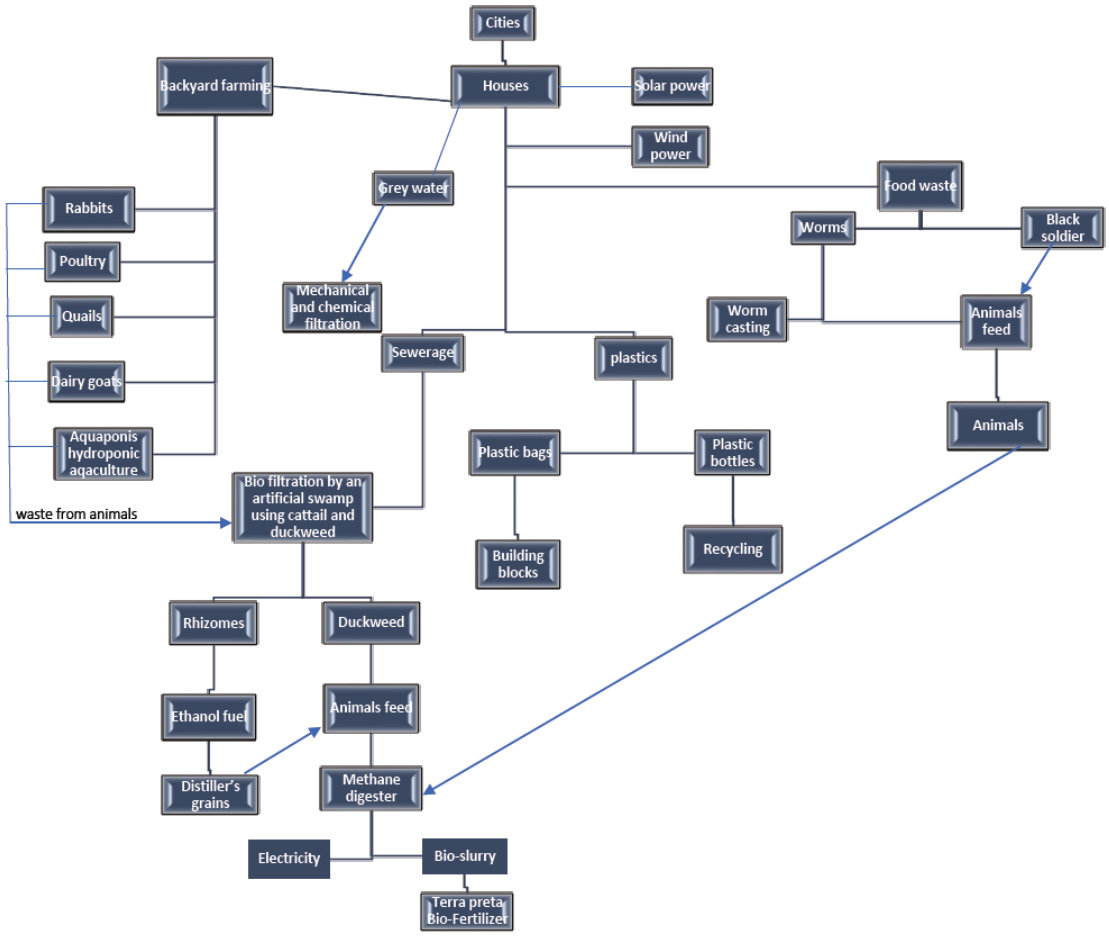


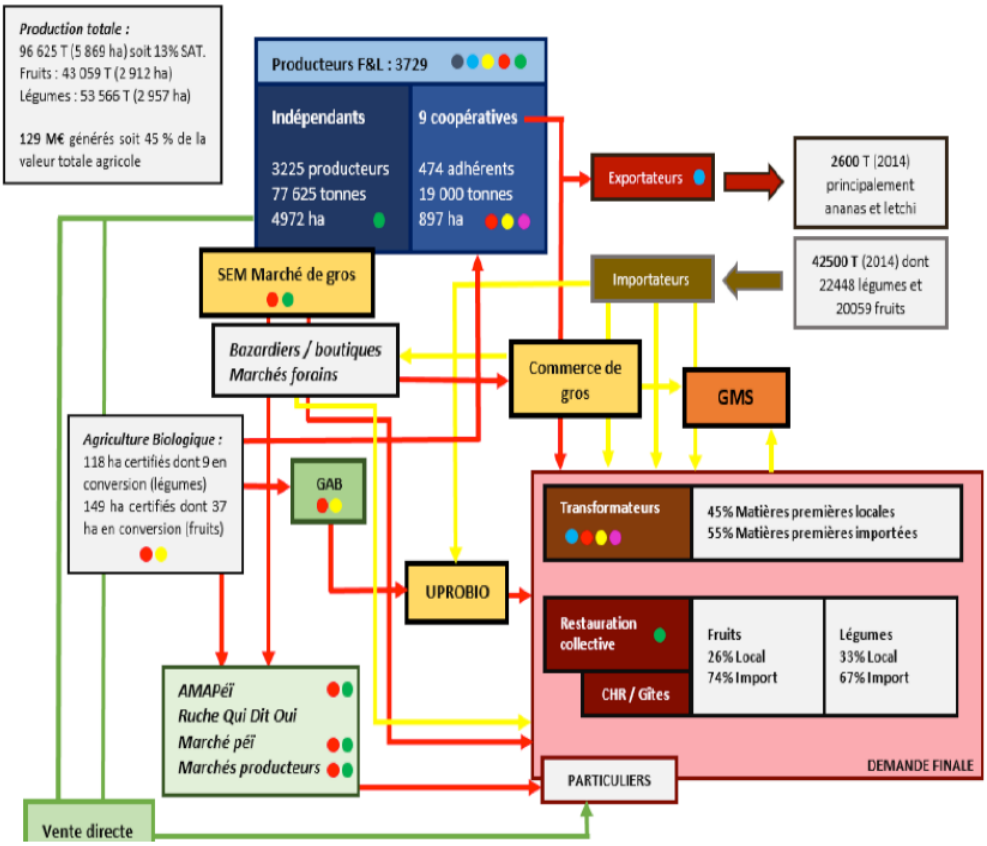
Diagram of the circular system of a rural farm (© Afraitane Chamsiddine)

- ## Considering production alongside consumption models

Building a more resilient system requires looking at both production and consumption.
Food practices and preferences can change. They have already changed over the last few decades, with the opening up and importing of highly processed products, which contribute to poor health and increased dependence on the outside world. Is allowing a McDonald's to be set up the best choice for revitalizing town centres? Questions about food education are also central to this issue.
The divide or misalignment between agricultural policy and food policy is therefore a problem.

- ## Eating locally?

The local scale is important for implementing policies. Distance creates cost and complications, whereas the local level allows for some fluidity. We are thinking of course of community-supported agriculture or vegetable box programmes, which put producers and consumers in direct contact with each other. Regional planning is also a tool for further developing this consumer-producer relationship (maintaining agriculture in urban and peri-urban areas, the circular economy, etc.).
However, reliance on local products has its limits. When preparing a simulation using the Parcelles application, we realized that 400,000 ha would be needed to feed the 850,000 inhabitants of Réunion Island. If we were to change the supply model, it would be possible that only 200,000 ha would be needed. But in Réunion, there are only 50,000 ha of production capacity! The existence of regional and international networks will remain essential to ensure food security for small islands. Existing cooperation in the Indian Ocean (notably between Réunion and Mauritius, where training for producers is offered and a production map has already been drawn up) is a good sign but still needs to be reinforced.



Mapping of the fruit and vegetable sector in Réunion (© Claire Cerdan)

How to achieve the energy transition and break through the isolation of island territories?

6 October 2020, 12:30pm–2:30pm (GMT +2)

Session moderated by Jean Grébert, Head of Mobility Systems at the IMD Institute for Sustainable Mobility Renault-ParisTech Foundation, member of Les Ateliers Board of Directors

Island territories, characterized by their isolation, are generally disconnected from continental electricity grids. This situation has led them to develop a significant dependence on fossil fuels. As such, islands share in the grand ambition of achieving the energy transition. The omnipresence of the sea, sun and wind allows for the development of renewable energies. Many pilot projects are exploring a range of possibilities and thereby confirming the islands' status as a "laboratory" for innovation: smart grids and the contribution of digital technology, agri-energy, thermal energy from the sea, electric vehicles, etc. What prospects do these experiments open up, especially for the most inaccessible areas? What consequences will they have on the land, which is limited by nature? What obstacles remain to be overcome?
It is important to recognize that these objectives will not be achievable without also considering the organization of daily life and consumption patterns. Mobility, agriculture, domestic cooking, waste production and recycling, tourism and more, are all elements that shape the ever-increasing demand for energy. Will island territories be successful models of an integrated energy development? How do urban planning and development contribute to this reflection? What territorial scales are relevant to meet these challenges? What existing know-how and new behaviours will make it possible to achieve these objectives?

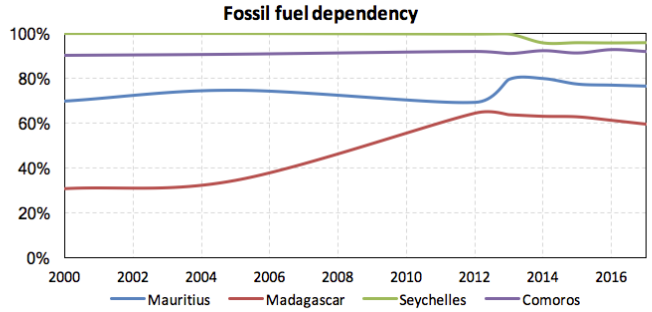
Introduction by **Cédric Vautier**, Regional Manager for Mauritius – Réunion – Seychelles, AFD Trois Océans
The French Development Agency is a forerunner in terms of supporting policies and projects that address climate change: 100% of the projects financed by AFD now meet the requirements for sustainable development and the fight against climate change outlined in the Paris Agreement. This is the case for projects such as photovoltaic farms (with Akuo in Réunion) or SUNREF, a green credit programme in Mauritius that promotes the energy transition. This commitment is accompanied by a myriad of questions, as approaches can differ depending on the stakeholders and certain trade-offs can be difficult to accept. For example, while biomass is clearly of interest, is bagasse a sufficient resource? How can these sectors be structured? Or what solutions can regional cooperation bring in the context of energy-isolated islands?

In order to offer a diverse overview of island energy issues, the guest speakers highlighted examples from numerous territories:
Hilda Dubrovsky, from the Fundacion Bariloche, shared Gustavo Barban's research on the decarbonization of the Galápagos Islands, which is pursuing the objective for 2040. The study shows that while technical solutions can largely reduce carbon production, tourism must also be redesigned so that the archipelago can become a virtuous territory in this respect.
Jessy Rosillette, a doctoral candidate at the University of Réunion, presented her work on energy transitions in island territories, focusing specifically on Réunion and Martinique. She emphasized the "laboratory" aspect that islands can have and the importance of taking into account the cultural and social specificities of each territory.
Mickaël Apaya, Head of Operations for Sustainable Development and Inclusive Growth at Business Mauritius, described the situation in Mauritius and in particular the role of the private sector in the energy transition.
Xavier Ducret, Regional Director of Akuo Energy (Indian Ocean), detailed the approach of an innovative player in the field of sustainable energy and shared his thoughts on the possibility of massively expanding renewable energy projects.

Jeanine Yeung, Project Officer for the European Union in the Indian Ocean, presented a project involving small-scale solar systems maintained by community women in isolated villages in Madagascar, and demonstrated how it encouraged local ownership of innovative solutions.
Finally, **Jean Grébert**, Head of Mobility Systems at the IMD Institute for Sustainable Mobility Renault-ParisTech, a member of the Board of Directors of Les Ateliers and moderator of the session, gave a brief presentation on Porto Santo (Madeira) and the possibilities offered by electric mobility, based on research conducted by Renault and the WWF.

A context dominated by fossil fuels

Islands are largely disconnected from the continental electricity and energy grids. Therefore, they must produce their own energy. However, their small size also renders them incapable of hosting the large infrastructure needed. As such, they depend above all on fossil fuels: coal, gas and fuel oil are the core components of island energy consumption.
In Martinique, Guadeloupe and Réunion, fuel oil dominates, followed by coal in Réunion and Guadeloupe. There is also a small amount of hydroelectricity in Réunion, geothermal energy in Guadeloupe and bagasse (fibrous by-product from sugar cane used for biofuel). In terms of primary energy, 80% of Mauritius' needs are met by fossil fuels produced by thermal power stations.
In the Galápagos, an archipelago in Ecuador, 1,000 km from the mainland and made up of 529 islands with an estimated 28,000 permanent inhabitants, energy demand in 2018 was 330,000 barrels of oil equivalent – 84% of which was related to transport, 60% of which was for maritime transport alone, with the latter being almost exclusively tied to tourism. The islands produce no hydrocarbons, so these are imported from the mainland. Solar and wind power are nevertheless becoming increasingly important in local electricity production.



Levels of fossil fuel dependency for Indian Ocean islands (World Bank/FSR data)

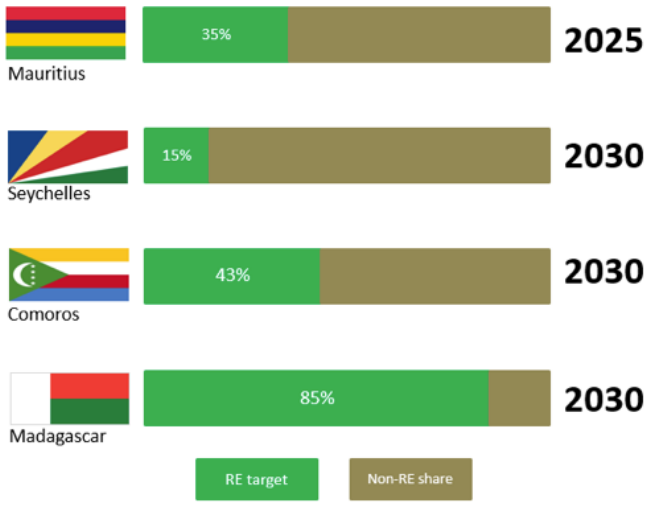
What means are needed to achieve these grand ambitions?

In Porto Santo (Portugal), the situation is similar: the island is 80% dependent on fuel oil, making the territory one of the most carbon-intensive in Europe. Despite this, it is pursuing an ambitious objective in which 99% of its energy will be renewable by 2030. Such high ambitions are also found in other island territories.

In the Galápagos, the government launched a 0% fuel initiative in 2007 to decarbonize the archipelago. The strategy consists of making solar and wind power the basis for domestic consumption, replacing gas cooking with electricity, and reducing the energy demand with more efficient equipment (notably air conditioners). Uses and demand must also change profoundly by 2040 in order to reshape the islands' energy matrix. Engines for motorized transport will have to become electric as well. However, the issue of reducing the carbon footprint of naval transport is a real challenge: large electric ships do not exist. In addition, biofuels are not a solution for challenges such as accidents and dumping at sea.

In mainland France and its islands, the "Energy Transition for Green Growth" law of 2015 called for 50% of energy to be generated from renewable resources by 2020 and full energy autonomy by 2030 for Non-Interconnected Zones. This objective was not met in 2020 (except for Corsica and French Guiana), and in fact calls for more of an electrical than an energy autonomy by 2030.

In Mauritius, the government is ambitious in its desire to reach 40% of renewable energy by 2030, but the means of achieving this do not appear to be sufficient While broad policy ambitions are present and have been met with general consensus, there are no regulatory responses, incentive frameworks and economic ecosystems currently in place – all of which will determine the success of such a transition.



Grand ambitions for a number of territories: Projected shares of renewable energy over the short term for Indian Ocean islands

Shared island specificities, but also very different landscapes

Island territories share similar challenges: they are often not connected to a continental electricity grid and the need for an energy transition is pressing. They are indeed small, highly carbon-intensive networks with obvious development patterns. For example, the impact of individual mobility, waste and fossil fuel consumption are quickly felt and noticed due to the limited size of the areas.

There are also important threshold effects. There are few power plants on islands, with some of them already reaching their end-of-life. But, the shutdown of a power station has serious repercussions, so decisions are crucial as any energy project can have widespread consequences that affect the entire island.

Due to this situation, islands are fertile grounds for experimentation. But, while we can speak of "creative destruction" (the disappearance of certain economic sectors leading simultaneously to the creation of new economic activities, Schumpeter), changes here can also prove extremely brutal. It is not easy to reorient jobs and industries that have been significantly destabilized by these changes. There is therefore often a great deal of resistance, whereas on mainlands the changeover is potentially smoother.

These shared situations should not obscure the specificities of each of the islands, which are to be found in their physical attributes (configuration of the territory, climate, hydraulic capacity, etc.), their

socio-political structure (political status, energy governance, regional and political influence), as well as in their cultural models and historical roots which condition the acceptability of any given model or project.

The island as a laboratory

Many articles have been written describing islands as "laboratories of energy transition" – showcase or test territories – both in scientific literature and publications for the general public.
Based on the deficiencies of the electrical network and the need to quickly transition, experiments are indeed legion in island territories. Often lured by financial incentives from island governments, the territories offer manufacturers visibility for their projects before they export them.
Among the many experiments, Akuo Energy has developed several solutions which should theoretically be possible to implement on a larger scale. Agrivoltaics and Agrinergie® allow for the coupling of agriculture and energy production on the same piece of land. A photovoltaic farm on Réunion Island also includes aquaculture, market gardening and solar energy. Solar energy storage is also being experimented with. Thermal energy from the sea has been the subject of work in Martinique (work that has currently been suspended by the head of the project).
In Porto Santo, Renault and the WWF hope to accelerate the transition to carbon-free mobility, beyond just the question of travel. They are therefore experimenting with how to capture and store renewable energy in car batteries, after which it is then returned to the electric grid and homes. In this way, the batteries of electric vehicles are reused for a second life in the home. By 2025, half of the car fleet (i.e. 1,500 vehicles) should be electric and will make it possible to achieve a 30% share of renewable energy. In 2030, the potential should reach its maximum: 100% electric cars and 99.5% renewable electricity.

Electric mobility as a resource for storing renewable energy and balancing the grid

The development of a consistent stock of electric cars, in shared or private fleets, will make it possible in the medium or long term to ensure a better balance between supply and demand in three ways: through smart charging, by the electricity operator, which will enable vehicles to be charged during periods of low consumption and at a lower cost; by managing peak consumption in the network through the punctual offloading of energy from vehicle batteries into home, neighbourhood (micro-grids) or full network grids; and finally by creating a form of the circular economy through the use of second-life electric car batteries that are placed in buildings equipped with photovoltaic panels on the roof, in order to store the renewable energy and release it according to consumption needs. The decarbonization of the territory can thus be supported by the further development of the electric car–renewable energy coupling. Islands, by virtue of their climate, orientation and inter-tropical geographical location, are well suited for the development of such solutions. Nevertheless, the issue of the final recycling of batteries at the end of their life cycle remains an issue that poses questions about the creation of a proper local industrial sector and, more broadly, about how to treat waste in an island environment.

The necessary inclusion of the population

The success of these projects is highly dependant on their acceptance by inhabitants. There is a certain level of mistrust of imported solutions, as they are seen to perpetuate the tradition of the "colonial laboratory" identified by Malcolm Ferdinand (*A de-colonial ecology: Thinking of ecology from a Caribbean perspective)*. Technology transfers cannot be carried out in the same way everywhere, especially when the historical and social dynamics are different. An example of such resistance was when the ASsociation pour la SAUvegarde du PAtrimoine MARtiniquais (AS.SAU.PA.MAR) blocked the port of Fort de France when the biomass power plant chimney arrived in Martinique in 2016.
Some projects, such as those related to agri-energy, require extensive preliminary work with local residents, farmers and local authorities to enable infrastructure maintenance, project development and sustainability.
In terms of successful inclusion, we can look at the European Union and Indian Ocean Commission's work for the Regional Energy Project. The solar energy project in Madagascar, completed in July 2019, has demonstrated a remarkable level of sustainability and serves as an example of a strong

handover by the Malagasy governor. The challenge was to provide solar electricity to an isolated community, part of the 5% of rural areas without access to energy means. The village is located in a mangrove ecosystem, accessible only by boat, with no public or private services. For this project, women were trained to assemble and repair small solar devices in their homes over a period of 5 months. Two hundred families are beneficiaries of this project in which shops can also stay open longer as well as schools. Ownership has been easier because of the involvement of the population. In a broader sense, it is also the evolution of behaviours and the management of the energy demand, particularly at the domestic level, which will condition energy needs.

The role of regulation

While changes in behaviour and the involvement of citizens are essential, these changes must also be reflected in the methods and roles of the authorities and various economic stakeholders engaged in this transition.

As part of the energy efficiency programme in Mauritius, it has been established that if all companies were to make energy savings, the impact would be massive: 10% of overall demand could be reduced. This would require diagnosis, cooperation and a reduction in consumption through innovation.

Governments must also take the initiative to regulate, by concentrating on sectors that are favourable to investment – employing investment planning to structure sectors as well as investing in training, local skills and even the development of an export strategy, particularly in Africa. The energy transition must therefore be designed around the 4Ds: decarbonization, digitalization, decentralization and democratization (the power to create one's own energy and share it).

Territorial planning offers a holistic vision that is conducive to an energy transition shared by all stakeholders

Solutions and experiments are therefore underway, but this moment in time is critical. The challenge now is to shift up a gear, and on a larger scale. In order to make this leap, it is useful to think in terms of "territorial planning": projects are part of a wider programme. Planning allows us to propose a broader vision, which does not focus on a single project and which puts the many ambitions back into play, along with the different actors concerned. How do the different projects and decisions influence each other and the development of the territory as a whole? How can the ambition of an energy transition be achieved within the limited space of an island? Territorial planning is a means for understanding the interactions between the different challenges, which then allows society and politicians to make the choices that are essential for the successful implementation of the energy transition.

In this respect, the issue of tourism and its development requires continuous attention to meet the objective. What will tourism look like after the pandemic? Will it still be a source of pollution and a consumer of energy? Can it generate desirable developments for ecosystems and populations?

Coastal development: Between ecological preservation and economic attractiveness

19 November 2020, 12:30pm–2:30pm (GMT+2)

Session moderated by Laurent Perrin, Senior architect–urban planner at the Institut Paris Région, and member of the Scientific Steering Committee of Les Ateliers.

Islands – land masses surrounded by water – are naturally characterized by their coasts. Whether they take the form of beaches, mangroves or coral reefs, or are backfilled or urbanized, coastlines are of paramount importance for the economy and identity of these territories. Nonetheless, these environments are particularly vulnerable to increasing anthropic pressure due to demographic growth and tourism development, but also increasingly to climate change and the natural risks associated with it.

Coastal erosion is an almost universal and unavoidable phenomenon. Should we fight against it or accept to abandon the land? How can the development of the blue economy be managed so that it does not compromise the integrity of marine ecosystems? And how can coastal urban development be gradually adapted to rising seas and the risks of coastal submersion?

Guest speakers:
Ariadna Anisimov, economist, researcher at the Institute for Sustainable Development and International Relations (IDDRI), specializing in governance tools and public policies for adapting to climate change
Thierry Paulais, economist, architect–urban planner, former director of the AFD office in Polynesia and co-author of the essay "Communs et océans. Le rahui en Polynésie"
Arlex Gomez, architect–urban planner from Honduras, thesis: "The Caribbean Basin in the face of climate change: What adaptations are possible?"

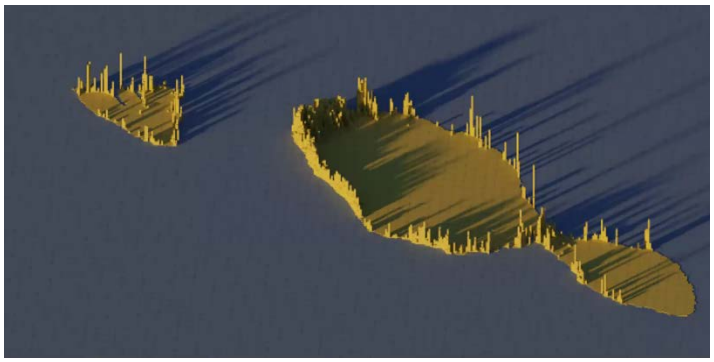
Introduction by **Cédric Vautier**, Regional Manager for Mauritius – Réunion – Seychelles, AFD Trois Océans
Coastline development and its relationship with climate change is crucial for the future of island territories. As part of the Mascarene archipelago, Réunion has 210 km of coastline, consisting of a coastal plain that is never more than 5 km long, but in which the vast majority of the island's economic activities are concentrated. In Mauritius (including Rodrigues), there are 390 km of coastline, which host a wide variety of rich ecosystems. Both territories experienced an average temperature increase of 1.2°C between 1950 and 2014. A further increase of 1°C to 2°C is expected by 2060.
One of the consequences of atmospheric warming is the accelerated rise in sea levels. Over the past decade, water levels have risen by 5.6 mm, and projections suggest a rise of 1 metre by 2100. To illustrate this drastic change, a 2012 Mauritian government study estimated that Mauritian beaches, the mainstay of the country's economy, would disappear by 2050! In addition to this disappearance, there are direct consequences for infrastructure, populations whose homes will be degraded, and ecosystems such as mangroves and coral reefs that will be permanently affected. The receding coastline also increases the vulnerability of buildings and roads in Réunion, and makes it necessary to build adapted infrastructures such as the New Coastal Road, one of the world's most expensive roads to build per kilometre.
The AFD already supports island territories and coastal areas through numerous projects. Examples include the study on coastal erosion and submersion in Mauritius and the impact study on the consequences of the Wakashio ship grounding in July 2020, which resulted in an oil spill along the island's beaches. In Réunion, AFD is supporting the construction of a marina by seeking a balance with ecological preservation.

Coastal areas, highly solicited spaces

The Ministry of the Sea is above all the ministry responsible for managing the uses of the sea, which is a common good for all.

Annick Girardin, Minister of the Sea

The issue of managing coastal areas is becoming increasingly important. These areas are indeed very much in demand. Coastal development is a massive phenomenon: people tend to live on the coast, sometimes in spectacular fashion in island territories. For example, in Tahiti and Mo'orea (Polynesia), the 205,000 inhabitants are concentrated on 230 km of coastline.



Representation of the demographic distribution on the islands of Tahiti and Mo'orea

To this occupation must be added the many and varied uses of the sea, which are also sources of conflict: port and industrial activities, fishing, tourism and leisure, national defence and maritime traffic security, support for marine biodiversity, etc.

Faced with the immense challenges posed by climate change, the study of solutions for sharing and managing this fragile and critical environment, the interface between land and sea, would appear to be particularly pertinent.

Learning from risk reduction pilot projects: The case of Mauritius

Mauritius has 380 km of coastline, 83% of which are sandy beaches. The island is highly exposed to climatic risks: erosion, rising sea levels, storms, coastal submersion, etc.

These vulnerabilities are exacerbated by human activities and man-made protection measures, which are more or less effective and respectful of natural phenomena. Water acidification and rising sea temperatures also threaten coral reefs: up to 80% of the reefs are considered to be dead according to observations, despite the fact that these ecosystems play an important role in the sedimentation process.

For example, 23% of the beaches studied in the research are experiencing severe erosion: this represents 22 sites and 1,100 buildings affected by erosion. Global warming scenarios show that regional trends will only increase this phenomenon.

What strategies have been applied to reduce coastal hazards in Mauritius?

Strategies have evolved from the 1970s to present day. This is due in particular to advances in the scientific community: the evidence and research on climate change has become increasingly compelling. Vulnerability and risk assessments specific to Mauritius emerged in the early 2000s, thanks to research and reports from private companies and international organizations (UNDP/JICA – the Japanese development organization).

As such, structural protection policies have also evolved. The hard infrastructure defence strategy of the 1970s (construction of dykes to cope with coastal erosion) has given way to alternative actions: ecosystem restoration, planting of indigenous vegetation, relocation of activities that increase vulnerability, artificial reefs, etc. This plethora of innovations can also be explained by the emergence of new governance tools, in particular integrated coastal management and environmental observation committees.

Three pilot projects were studied to reflect the diversity of options:

First, the reinforcement of the dyke at Rivière des Galets, which took place between 2012 and 2016, is an example of 'hard' structural protection. A local hearing was conducted in 2012 to decide whether to reinforce the dyke or to relocate activities threatened by erosion, but a consensus was never reached. Relocation was the more expensive option, but would have however provided long-term protection from climate change. Nevertheless, the local community, marked by poverty, was highly attached to the site.

Rivière des Galets, © Ariadna Anisimov

The wall was therefore reinforced between 2014 and 2016. The wall protects the residential areas but stops at the commune's cemetery, which is still exposed. It is not certain that this solution will be sufficient in the long term. It is expensive to maintain and has limited capacity in the event of a rise in sea level. The study concludes that the sea wall offers a false sense of security to the community, which may be further impoverished by a disaster.

Secondly, the 2013 mangrove planting in Grand Sable in the east of the island is a good example of a nature-based solution, which included the participation of the local community. The town and the road were located very close to the sea. The initiative, funded by the UNDP, relied on the fishing community in particular. This participation helped to create an involvement by the inhabitants in the protection of their environment. In parallel, JICA funded the installation of a gravel beach to absorb water and protect the community. However, the project has experienced some difficulties in terms of coordination between ministries and institutions, with instances of competition for funds.

Grand Sable, © Ariadna Anisimov

Finally, in Saint-Felix, in the south of the island, the relocation of activities is illustrated by the shifting of the coastal road inland from 2017 to 2019. This project was led by the government and the integrated coastal zone management department. The coastal road was previously flooded every year, which meant that mobility came to a halt, while the road's foundations continued to erode. The government reached an agreement with the private sector to relocate the road. The owners of the land wanted to diversify their business, so there was land swap that was welcomed by both the private and local stakeholders. The area close to the sea became a recreational area while the road was moved back: the risk of flooding was reduced.

Saint-Félix, © Ariadna Anisimov

In addition to these three collective projects, it is important to look at individuals and their actions with regard to erosion. At Pointe d'Esny, in order to protect the houses threatened by regular flooding and the loss of the beach, the inhabitants have built their own individual dykes, but in an uncoordinated manner: this has ultimately led to even more erosion. Fragmented beach management is damaging.

Esny, © Ariadna Anisimov

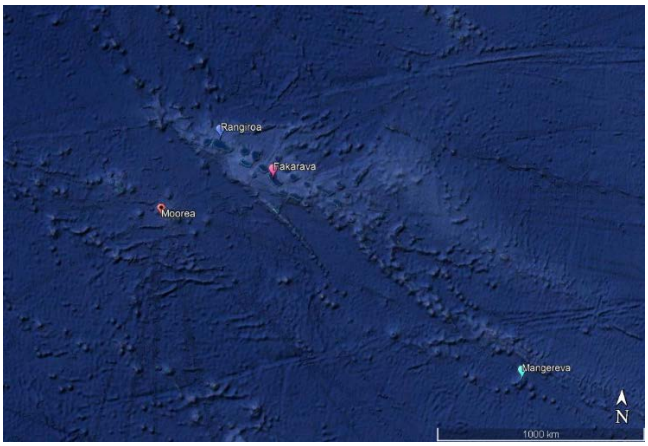
These examples are a source of satisfaction. The diversity of responses shows a certain flexibility and capacity to experiment, particularly in relation to local communities. The notion of stakeholder acceptability is central to the negotiations and solutions put in place.

Nevertheless, these ad hoc projects do not feed into a shared, long-term coastal risk adaptation plan. They lack systematic risk assessment, and moreover it would be desirable if these practices could be

a source of learning for institutions. A degree of inter-ministerial coordination and integrated management are important tools to bring together. At the same time, flexible governance allows for experimental projects to adapt and learn systematically from risk and vulnerability conditions.
This presentation was based on an IDDRI publication by Ariadna Anisimov, Alexandre K. Magnan, Virginie K.E. Duvat, Learning from risk reduction pilot projects for enhancing long-term adaptation governance: The case of Mauritius Island (Indian Ocean), Environmental Science & Policy, Volume 108, 2020, Pages 93-103.

Conflicts of use and the Commons: The case of Polynesian lagoons

The Commons is a concept popularized by Elinor Ostrom, winner of the 2009 Nobel Prize in Economics. In short, it refers to shared resources that are managed and maintained collectively. Some communities manage problems outside the market and in a self-managed way that would otherwise be handled by public authorities. The Commons therefore require a collective agreement to not plunder the resource.
The Commons, applied in the Polynesian tradition, can contribute to the adaptation of an approach to managing spaces. The examples are based on the remote territories of Polynesia, namely the Tuamotu archipelago, Mo'orea, and Mangareva.



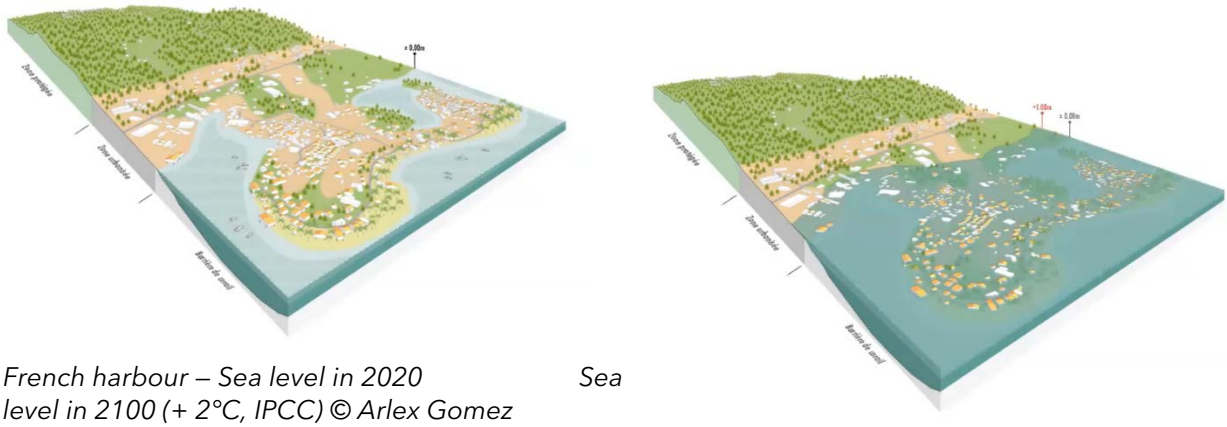
Location of the cited Polynesian islands (Google Earth)

Within the "Common Pool" (the collective property; in this case, the lagoon), several uses exist in a limited space. Fishing (surface or underwater), fish farms, aquaculture, pearl farming, luxury tourism, green tourism and scuba diving are all activities in the lagoon that can come into conflict.
Some examples of conflict and remediation:
In Tuamotu, the island of Rangiroa is a telling example. Tourist activity is heavily concentrated around the lagoon, near the most fish-rich waters — the Tiputa Pass. There are six dive clubs in Rangiroa, each sending a dozen divers to the same place at the same time. Cruise ships add to this population, surface and underwater fishermen are also present in this coveted area, not to mention snorkelling hotel tourists. Conflicts have arisen and the municipality has organized a hearing to demarcate different areas for sailing, diving and fishing.
Fakarava is home to the "shark wall", the largest concentration of sharks in the world. This small area attracts hundreds of thousands of tourists every year. The hotels are numerous, and this intense activity not only generates a lot of waste, but is also confronted with a cruel lack of drinking water.
In Mangereva, some sixty pearl farms generate considerable waste that accumulates in the lagoon: one pearl farm produces two tons of waste per year. This activity is also a source of employment for a poorly qualified workforce, often from Papeete. These people live on site and the local population has therefore increased significantly. Unfortunately, this demographic increase generates fresh water problems: the water table became so depleted that it only produced brackish water. A desalination plant had to be installed.
In Mo'orea (an island of a different size, with 20,000 inhabitants), an intense cruise ship industry goes hand in hand with the large pineapple plantations, resulting in the use of fertilizers that pollute the lagoon. To regulate conflicts, Mo'orea uses a modern tool: the Mo'orea Maritime Space Management Plan, which maps and delimits uses and protected areas.

Fakarava is an island listed as a Biosphere Reserve by UNESCO. This provides the island with specific protections, nevertheless these protections have not resolved everything.
The *rahui* is an ancestral Polynesian device that has gradually fallen into disuse. The rahui is a marine or terrestrial reserve in which humans are not allowed to enter for a certain period of time. The reason for setting up a rahui was not originally ecological but political. It was used by groups to prohibit access to specific spaces and the taking of their resources for variable periods of time. The practice is being revived in a contemporary manner, motivated by environmental issues, and is now identified by yellow buoys demarcating fallow spaces managed at the local level.
The use of the rahui thus shows how an ancient solution can correspond to contemporary concepts and aspirations, resulting in a hybrid vision of the Commons. Embedding modern solutions in local system is a good way to engage people in the preservation of their environment.
This presentation was based on the book ***Communs et océans – Le râhui en Polynésie****, Tamatoa Bambridge, François Gaulme, Christian Montet, Thierry Paulais, Édition Au Vent des Îles, 2019*

Architectural adaptations and tourism development: The Island of Roatán

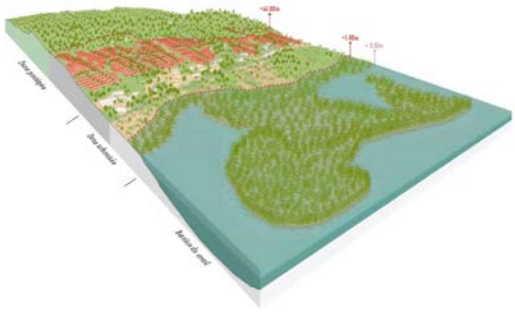
Roatán Island is part of Honduras, a Central American country of 8 million inhabitants. Tourism represents 6% of the country's GDP, and the island of Roatán plays an important role in Honduran tourism. This activity has developed since the 1970s, thanks in particular to the installation of the international airport. The island, which is English-speaking, has 71,300 inhabitants and is experiencing a steady demographic growth. It welcomes 2.5 million tourists per year, 80% of whom come by cruise ship and 20% by plane. There is a significant economic gap between the mainland and the island, as shown by the difference in the unemployment rate (5% on the island, 24% for the rest of the country). Ninety percent of the island is protected, in particular its tropical forests and the coral reef, which belongs to the Great Mesoamerican Barrier Reef. The island is relatively food dependent on the mainland. Urbanization has taken place along the coastline, with fishing villages gradually growing. The south of the island is more developed than the north, since tourist activities are concentrated there with their connection to the airport and the port.
The consequences of climate change are already visible. The increase in cyclone activity is clear. Periods of drought are longer than before. Sea levels are rising significantly. Moreover, the IPCC forecasts suggest that these phenomena will accelerate within a few decades. The coral reef will be severely impacted, and the urbanized area will be mostly submerged.



French harbour – Sea level in 2020 *Sea level in 2100 (+ 2°C, IPCC) © Arlex Gomez*

In what ways can these problems be tackled?

- First of all, through the preservation and restoration of threatened ecosystems, with land use adapted to the new climatic conditions. The planting of mangroves can protect threatened areas, and the regeneration of the coral reef is also an important tool. The establishment of blue and green infrastructure allows water to circulate and prevents landslides during storms.



Mangrove restoration for a resilient ecosystem? © Arlex Gomez

- Architecture can be adapted to conditions, especially for living higher up, on uneven terrain, using more resistant and biodegradable materials which respect the terrain and which take advantage of tropical conditions. These structures can be equipped with terraces built according to the slope and with solar panels facing south. Carbon fibre can be used to reinforce wooden constructions and the orientation of the buildings can be chosen by considering hurricane winds.

Building orientations based on hurricane wind patterns © Arlex Gomez

- The tourism model can be transitioned away from marine life observation activities. There is a significant risk that the beaches will disappear in the long term. On the hillsides, new activities such as the observation of mountain fauna and flora could be made possible by cable car access.

However, the Honduran government is currently more concerned with exploiting resources than protecting ecosystems and is not in a position to hear suggestions otherwise. Even though 90% of the island is protected, it is issuing new authorizations to develop hotel complexes.

Integrated, natural and diverse responses to shared challenges

Far from being reducible to technical issues, the challenges posed by the consequences of climate change on the coasts show the need to work in a transversal and integrated manner. The Management of Aquatic Environments and Flood Prevention (GEMAPI), recently conferred to the Réunion Communauté d'Agglomération, is an example of an evolution in this direction.

In general, "hard" solutions such as dykes have shown their limits when faced with large-scale changes, while nature-based solutions are more flexible and resilient. They are also often more in tune with local cultures: the active support of the population appears to be a major asset in facing the challenges of climate change.

Island voices: A synthesis

Jean Grébert

Islands are a concentrated patchwork of multiple geographical realities where each aspect of their situation and orientation has an amplified significance and impact. Because of their geographical situation, islands, often volcanic, are exposed to great risks but also offer great opportunities. What are the risks to be reckoned with in the face of climate change?
There have been a lot of questions about security, food, energy and transition, which refer to the autonomy and dependence of these territories. What have we talked about in this series of Island Voices that will contribute to the preparation and creation of an Island Territories programme?
We've talked about **small island states**, and small island economies, a UN analytical category and statistical unit. Production costs are high due to isolation, remoteness and a small domestic market. There is no large-scale production. The small size of islands means that they cannot accommodate large-scale energy infrastructure. Natural resources are limited (are they unlimited elsewhere?); isolation and the limited market, the low level of diversification, puts island economies in a position of vulnerability, of dependence on external partners. Large farms following the conventional model are highly subsidized; heavy dependence on coal and fuel oil in Mauritius and Réunion, the electricity produced in Réunion costs 2 to 3 times more, largely subsidized by national redistribution. Mobility is central to this consumption in terms of challenges, including maritime transport.
Threshold effects are pronounced.

How to build or rebuild resilience?

- One way to build resilience is through **diversity**: be it by strengthening it if it already exists or through **diversification** if it needs to be created. Single-crop farming can be complemented by diversified, small-scale family farming. The energy mix can be rebalanced and decarbonized through the dissemination of renewable energy. All this shows the multi-performance of decentralized solutions in terms of agriculture, energy, natural resource management, waste treatment, the reinforcement of the role of the local.

- It is important to **innovate** and consider the **islands as a laboratory** by drawing on local know-how. A notable feature of the islands is the exodus of skills to the exterior. There is much talk of the French guava syndrome in Réunion. Local development needs to be promoted. A real role and demand for "made locally". Identification of good practices, promotion of know-how, new players. The COVID pandemic has made people even more aware of the island's insularity, of a certain autarky, even of a confinement, and above all of a strong dependence on imports of certain foodstuffs which could be produced locally (onions, garlic imported from Australia or China to Réunion). Highly ecosystemic agroecology is a path that is being experimented with, particularly in East Africa (Comorian expert based in Uganda, 2-minute film for Island Voices). A change of model can save space. Agro-ecology, agro-energy, decentralized off-grid micro-grids, new forms of storage and distribution of resources to ensure the provision of islands. Innovation means scaling up, deployment and massification of practices. The involvement of the population is a central vector for acceptance, the evolution of behaviours and the adoption of solutions.

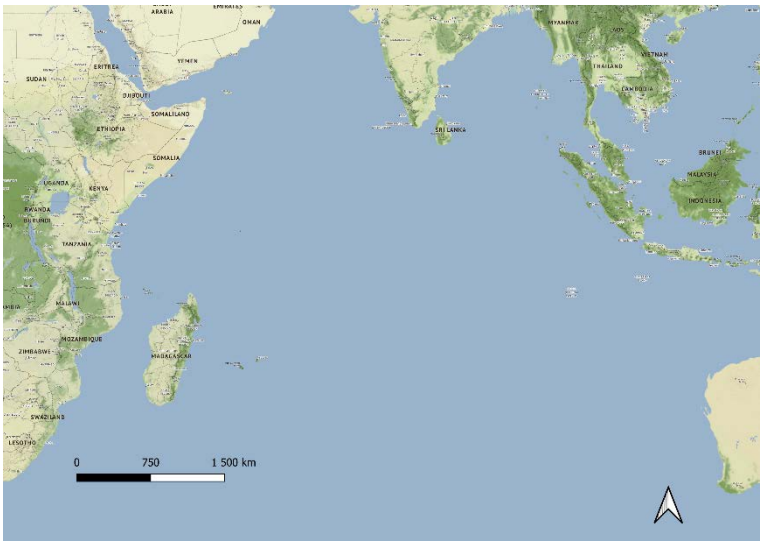
- An **ecosystemic approach** to interactions, a **mutualization of activities** and their use of shared resources: space, energy, water, etc. Interactions between multiple domains: agriculture, waste, energy, mobility, construction, tourism, etc. Central role of the circular economy to be made more effective. Especially in the ultra-marine territories, population density is high and physical space is saturated. There is competition for available space for new activities, leading to even greater vulnerability (food security).

In conclusion, resilience in the face of climate change and the risks it poses implies thinking about production alongside the consumption model. Consumers must be involved in the collective management of resources, and be real managers of demand so as not to run into a problem of supply.

Major political ambitions are present but regulatory responses and incentive frameworks are not yet in place.
Territorial planning is the prism through which these issues converge – offering a physical reality to organize, plan and design the territories in a real design-focused thinking of the ecosystem.

Indian Ocean Territories: An introduction

INDIAN OCEAN



General presentation

The archipelagos of the Comoros (Union of the Comoros, Mayotte), the Mascarene Islands (Reunion, Mauritius, Rodrigues) and the Seychelles (Mahé, Praslin, La Digue...) constitute, with Madagascar, a unique regional unit, the only Afro-Eurasian civilizational centre., fashioned between the 7th and 18th centuries, in one of the last inhabited places on the planet. These islands were populated by various migratory flows from the port cities of the Indian Ocean, as part of the long-distance trade as well as the slave trade. Today they are an integral part of what one could call an "acculturation area", that is to say an interface zone where mixtures of populations of various origins prevail who circulate or are displaced within each island and from one island to another and where creolization predominates.

The unity of this island space is based on the same geography, common environmental fragilities, similar climatic conditions, a more or less similar general morphology (with, however, different geological histories) and a common settlement history. The other great common point is of course the insularity, at different scales, the relationship to space cannot be the same in the large island of Madagascar and those of the Comoran or Seychellois archipelagos. Each of the islands nevertheless has a very unique personality due to the variety and unique combination of their environmental, social, economic and political contexts. Socio-economically, the whole is divided into two groups, which pit the islands of the Comoran archipelago and Madagascar against the Creole Mascarenes Islands (Mauritius and Reunion) and the Seychelles. The former have a very young and rapidly growing population, underdeveloped economies and a fairly low human development index. The latter have a less young population with more moderate growth, more advanced and diversified economies and a fairly high human development index. From an environmental perspective, each of the islands has a variety of unique ecosystems and microclimates.

In 1982, Madagascar, Mauritius and the Seychelles laid the foundations for institutionalized cooperation, materialized by the creation of the Indian Ocean Commission (IOC) in 1984. In January 1986, France, via its department of Reunion, and the Comoros, join the Indian Ocean Commission. The common cultural base of these islands is the basis of a spirit of solidarity which has animated the regional cooperation implemented by the IOC for more than 30 years. Indeed, within the limits of its means and with the help of international donors, the I.O.C. has carried out various projects in a range of sectors such as sustainable fishing, preservation of ecosystems, entrepreneurship, maritime safety, food security, public health, renewable energies and peace and stability. The only regional organization in Africa composed exclusively of islands, it defends the specificities of its member states on the continental and international stages. We are therefore talking more and more about Indian Oceanic culture. Today, "Indianoceania" has officially become the name of the islands in the south-western Indian Ocean. The Indian Ocean Commission uses it in its documents, its position papers. Mayotte nevertheless remains excluded from the I.O.C. the foreign ministers of the member countries having always refused the integration of Mayotte, because of the question of the sovereignty of the island.

Intra-I.O.C. economic exchanges are undoubtedly the sector where the concrete results have been the weakest. According to IOC figures, intra-IOC trade in products (excluding services) represented, in 2018, only 3 to 5% of the islands' total trade and is mainly concentrated between Mauritius, Madagascar and Reunion, taking into account their respective economic weight. Manufactured products, intermediates, and raw materials predominate in intra-regional exports. Europe and the United States therefore remain the region's largest export markets for the time being. However, the Indian Ocean Islands have a lot to gain from developing intra-regional trade, in particular to: reduce their international dependence in the agro-food sector, reduce storage problems, reduce supply costs, reduce dependence on global price fluctuations , improve employment and income for the region's inhabitants, and finally reduce CO2 emissions. To this end, the Union of Indian Ocean Chambers of Commerce and Industry developed in 2018 a unique digital platform aimed at supporting economic and trade exchanges between the islands of the I.O.C. and Mayotte.

Despite a strong common history, many sources of common settlement, common cultural practices, common religions and languages... these links are not highlighted very much and the cultural and regional identity of the Indian Ocean is struggling to emerge. set up and be felt both locally and internationally. The similarities but also the richness of the cultural particularities of each island would make it possible to generate new so-called "Indianoceania" creations. For the moment, the only areas where lasting exchanges are taking place concern cinematographic creation and certain initiatives around Creole music.

Nowadays, the Western Indian Ocean (WIO) region is subject to significant migratory pressures, which come both from internal movements within the region itself, but also from other regions, such as Africa. of the Great Lakes. Interregional migratory flows are essentially reflected in Comoran migrations towards Mayotte (it is estimated that more than 100,000 Comoran live in Mayotte). In general, Mayotte is particularly affected by illegal immigration, flowing from all over Africa, and representing 30 to 50% of the population. In Reunion, the majority (73%) of immigrants settled in the island come from an island in the Indian Ocean: Madagascar (40%), Mauritius (21%), Archipelago of the Comoros (11%) 1. About 10,000 people leave Reunion every year to settle in mainland France, and conversely, 10,000 people leave the mainland to settle in Reunion Island. In Madagascar, the foreign population is poorly known through the available statistics. Unofficially, it would amount to an average of 80,000 people, well above statistical estimates. The most represented nationalities would be, in decreasing order of importance, the French, the Chinese and the Indo-Pakistanis, and finally the Comoran. The rate of Malagasy emigration is extremely modest: less than a hundred thousand live abroad, or less than 0.5% of the population 2. Population movements in Mauritius and the Seychelles are relatively low and revolve mainly around labor migration.

The "Indianoceanian" Islands in the face of climate change

The island states of the Western Indian Ocean share common characteristics, both in terms of their climates and ecosystems and in terms of their exposure and vulnerability to phenomena, the impacts of which are now exacerbated by climate change and other environmental degradations. Indeed, although they contribute very little to the climate emergency (0.03% of global CO2 3 emissions), these States are direct witnesses and among the most affected by the effects of climate change. In addition, "Indianoceania" is the second most vulnerable region in the world to natural disasters.

For the past fifty years, the WIO states have been facing a net warming of oceanic and thermal temperatures, an increase in the frequency of thermal anomalies, an overall decrease in precipitation, an intensification of cyclonic phenomena, an increase in the frequency of thermal anomalies. significant rise in sea level, a considerable decline in coral, a decrease in the presence of fish, as well as coastal erosion. These growing phenomena affect the means of subsistence and security (food, economic, physical) of the 30 million people living in the region, largely dependent on the natural resources of their territory.

The decrease in freshwater resources, the intensification of droughts and the increase in the number of thunderstorms can lead to an increase in health risks, via a development of pests and contagious diseases as well as an alteration in the geographical distribution of vectors like mosquito.

Tourism, which represents a major economic activity in the WIO is also expected to be strongly affected: coastal erosion and rising sea levels threaten tourism infrastructure, while changes in climatic conditions, degradation of ecosystems and the biodiversity could affect tourism activities. More generally, all critical infrastructures are threatened, such as hospitals, ports, airports, power plants, schools, roads, etc., representing a real risk for the populations living in the places. exposed.

The precariousness of the populations of the WIO could reinforce the phenomena of rural exodus and inter-island migration, causing problems of demographic pressure on already saturated territories as well as growing problems of illegal immigration.

However, if the geographic specificities of these territories are at the origin of their vulnerability, they are also a source of countless opportunities and assets, especially in terms of sustainable development.

What regional cooperation for enhanced resilience in the face of climate change?

Sharing many common issues, regional cooperation is an opportunity for each island to be able to work together in order to think about and put in place viable and effective solutions, taking into account the peculiarities of each, to improve their resilience in the face of the consequences of change. climate. Sustainable development issues are therefore today at the heart of cooperation between Indianoceanian States, which essentially takes shape through the C.O.I. Indeed, the actions of the I.O.C. focus more and more on the preservation of the environment and the sustainable management of natural resources. The latter has in this sense recognized expertise in environmental matters and frequently pleads in international events for recognition of the specificity of its members and their vulnerability to the effects of climate change and for special treatment by the international community in the allocation of public aid.

In terms of natural risk management, the programs implemented by the I.O.C. aim in particular to improve knowledge and understanding of climate risks in the Member States in order to strengthen resilience, national capacities for the prevention and management of crises or for forecasting. seasonal. The I.O.C.has also developed its regional plan for adaptation to the effects of climate change and disaster risk reduction.

The I.O.C. also intends to promote inter-island cooperation in the "blue economy" sector, which involves responsible and sustainable exploitation of natural maritime resources. Numerous projects have thus been set up, aimed at improving the knowledge and assessment of tuna stocks, at strengthening the monitoring, control and surveillance of fisheries or even at consolidating sectors through responsible exploitation of the resource4.

For several years, Member States have been confronted with increasingly recurring issues of waste management and reduction and the I.O.C. has carried out operations on several occasions to support States on these issues. In 2019, an action plan to reduce and manage waste in the countries of the Indian Ocean Commission was notably developed. The ExPLOI project is part of this framework and revolves around three axes: improving knowledge of the impacts of marine plastic pollution, environmental education and awareness of plastic pollution and the development of a regional circular economy.

Restoration of ecosystems is also at the heart of the cooperation of the IOC islands. The Coastal Zone Resilience Project, which aims to implement activities for the sustainable restoration of coastal ecosystems, based on nature-based solutions, was launched in 2020.

Created in 2014 from a cooperation between the IOC, the French State, the Réunion Region and CIRAD, the Regional Platform in Agronomic Research for Development brings together around twenty organizations and institutions present in the IOC Member States., represent local public institutions, research and higher education organizations, technical institutions and non-governmental organizations that support farmers on a daily basis5. PRéRAD-OI is preparing the construction of the Indian Ocean Agriculture Observatory, which will support the transformation of farms in their diversity, with a view to contributing to the agroecological transition in the WIO region.

Electricity access rates vary considerably among I.O.C member states, but they are nevertheless all more or less dependent on hydrocarbons. However, the development potential of renewable energies is real and highlighted by the ENERGIE program. This program notably co-finances 16 projects aimed at producing electricity using renewable energies in the Comoros, Rodrigues (Mauritius) and Madagascar. This program should also promote the pooling of expertise and the development of tools for the transfer of know-how and technology from the experiences of each territory.

The regional integration of Mayotte, which is not part of the I.O.C is encouraged, in particular, by the INTERREG IO territorial cooperation program. This program aims to strengthen cooperation in the IO, in particular between Réunion, Mayotte and the States of the I.O.C. 6. Two of the major priorities of this program are to strengthen collective capacities for adaptation to climate change and risk management as well as to strengthen capacities for knowledge and promotion of the natural and cultural heritage of the Indian Ocean area.

1. NSEE, 2013
2. https://journals.openedition.org/eps/4131#tocto2n1, 2010
3. https://www.commissionoceanindien.org/wp-content/uploads/2019/10/LNP-COI-Enjeux-et-solidarit%C3%A9s-insulaires.pdf
4. https://www.commissionoceanindien.org/wp-content/uploads/2019/10/LNP-COI-Enjeux-et-solidarit%C3%A9s-insulaires.pdf
5.
6. also with Mozambique, Tanzania, Kenya, Maldives, India, Australia, TAAF:

MAURITIUS

Mauritius island (upper) and Rodrigues (below)

General presentation

Republic of Mauritius: made up of the main island of Mauritius, Rodrigues Island as well as the archipelagos of Agaléga and Saint-Brandon (also called Cargados Carajos)
Geographical location: southwest Indian Ocean, Mascarene archipelago
Area: 2040 km2
Population: 1,270,000
Density: 630 inhabitants / km2 (the largest in Africa)
Population growth: 0.04%, Mauritius has completed its demographic transition and has been facing an aging population for several years.
Urbanization: 42% (estimated at 60% in 2050). The capital, Port Louis, is a small port town of 150,000 inhabitants, but forms a conurbation of 520,000 inhabitants with the country's 4 other official towns, all located in the Plaine Wilhems district in the interior of the island. All the other agglomerations of Mauritius proper have a rural status (VCA).

Of volcanic origin, Mauritius no longer has active volcanoes and has **a fairly uneven relief**. The highest peak is the Piton de la Rivière Noire (828m), followed by Pieter Both (821m) and du Pouce (812m). Mauritius includes **a vast central plateau** 500m above sea level, shared between towns and what remains of its primary forest (only 2% of primary forest survived the intensification of cultivation and the establishment of exogenous species). **The island's lagoons extend over 243 km2** and are surrounded by **an almost continuous barrier reef about 150 km** in length, interrupted in three places, to the west and to the south-east, for some 30 km. It is home to nearly **200 species of corals** among the 800 species recorded in the world.

The relief of Mauritius, although not very hectic, and the influence of the prevailing winds that are the trade winds from the south-east, generate significant differences in microclimates between on the one hand the coast and the "highs" of the central plateau, and on the other hand the "upwind" and "leeward" sectors. In general, **the island's climate is that of the tropical regions of the southern hemisphere**, with the southern summer from November to April, humid and hot, and winter from May to October, cooler and more dry. **Tropical depressions and cyclones**, which generally occur in this region of the Indian Ocean between November and March, affect Mauritius quite regularly, causing significant damage there due to intense winds, waves and rains.

Mauritius is home to a cultural diversity made up of a heterogeneous population with diverse origins, the fruit of a fragmented history. Long uninhabited, Mauritius was first colonized by the Dutch in 1638, then by the French in 1721, and finally by the English in 1814 until the island's independence in 1968. The country has therefore experienced different waves of immigration, between colonization, slavery and engaging. Today, 68% of the population is descended from Indian workers, 27% are Creole (descendants of slaves), 3% are of Chinese origin and 2% are European (mainly French). Due to this great ethnic diversity, the vast majority of Mauritians are multilingual. Many languages coexist, such as English, French, Urdu, Hindi, Bhojpuri and Mauritian Creole. Although English is the official language, Creole and French are the most popular languages. There is also a great multitude of beliefs and religions in Mauritius. Hinduism is the most popular religion, with 48.2% of followers,

followed by Christians (30%, mainly Catholics), and Muslims (17.5%). Buddhism, the 4th largest religion on the island, represents only 1% of the population1.

In terms of wealth per capita, Mauritius is the richest country in Africa. The Mauritian State is modeled on the British liberal model marked by a certain laissez-faire, and relies on the private sector to develop the country (a sector today largely dominated by three large groups: IBL, Ciel and ENL) . Since independence in 1968, when Mauritius was largely dependent on sugar, the country has embarked on a diversification of its economy by developing in particular the textile sector, tourism and the service sector, then, since the 2000s, financial services and the information and communication industries. According to the IMF, in 2017 the informal sector represented 20 to 25% of the Mauritian economy, a relatively low rate for a country in sub-Saharan Africa. The Covid crisis has impacted most sectors of the Mauritian economy (except information / communication services and financial services). Measures to protect people from the informal sector or working on their own were taken during the lockdown, allowing them to receive 50% of the Mauritian minimum wage.

The major environmental issues

Concretely, in Mauritius, climate change results mainly in **an overall decrease in annual precipitation**, incompatible with a context of increasing demand for water. Conversely, **the multiplication of brief and intense phenomena**, which cause **the surge in water levels**, are causing significant damage, especially to farmers and their land. **The damage caused to crops** by torrential rains has been estimated at 80% in some areas, with a significant impact on the availability and price of local vegetables.

Human activities such as mass tourism, net fishing, water pollution, unsustainable management of coastlines, agricultural pesticides, fertilizers, etc. have severely damaged the ecosystem. With 80% of its endemic plants threatened with extinction, Mauritius has been classified by the IUCN **as the third world country with the most endangered flora.** Coral reefs in particular are threatened, with over 75% of coral reefs damaged. The beaches are also suffering the consequences of climate change: since the 1960s, **its coasts have been eroded by 10%**, due to erosion and rising sea levels. We can also mention wetlands, which are among the most productive ecosystems in the world and which have essential value for the environment as well as for human populations. Despite their legal protection, development projects continue to flood in and **threaten more than 90% of the remaining wetlands today.**

The example of **the oil spill** that hit Mauritius at the end of July 2020 revealed **the country's vulnerabilities in terms of its ability to withstand external shocks**: a Japanese bulk carrier struck a reef in the south-east of Mauritius, leaving about 1000 tons of oil. The accident caused **a veritable ecological disaster**, the long-term effects of which are not yet measurable, and severely affected the lives and livelihoods of many people in the country. The disaster provoked strong reactions from the population, who criticized the government for failing to anticipate the scale of the disaster and for having taken too long to react.

Finally, Mauritius has to face **various challenges in terms of waste management** such as increased waste production, a single landfill centre which is reaching saturation, the unavailability of new infrastructure or a low recycling rate (less than 10%).

What strategies for a sustainable society?

a) The agricultural transition

Mauritius is largely dependent on the outside for its food supply, as **the country imports 77% of its food**. Most of the land and economic development has focused on real estate construction, hotels and luxury residences, which has diverted the population from subsistence farming and landowner investors from agro-industry. In addition, Mauritius has **a very poorly diversified agricultural sector**: cane largely dominates the sector and is mainly based on the model of industrial agriculture around this sector. Industrial agriculture has fostered **monoculture**, which **has negatively impacted**

biodiversity, altered the behaviour of pests and pathogens, deteriorated soil biology and reduced the climate resilience of agricultural production systems. In addition, recent drops in world sugar prices have discouraged farmers and due to the lack of other alternatives the land is in an abandoned state. The COVID-19 crisis has highlighted the need for Mauritius to become more food self-sufficient and attract new farmers keen to develop alternative and sustainable farming systems. Pilot projects for the development of reasoned agriculture, agroecology and permaculture have been set up and offer a real opportunity to move towards diversified organic production. The EMBEROI program, for example, coordinated by the Reunion Island association isolife, in partnership with the Mauritius green bike association, offers pilot farms on the two islands the benefit of training programs in agroecology. Another example is the EU-funded "smart agriculture" project, which promotes the adoption of innovative techniques that avoid the use of herbicides and pesticides while increasing the resilience of agriculture to climate change. However, if the Mauritian government has made a commitment in recent years to promote organic farming to ensure food security and improve the quality of the environment, the latest agricultural policies have so far failed to bring about a real change. .

b) Energy transition

Mauritius is largely dependent on the import of fossil fuels: these provide 84% of the country's primary energy needs. The energy sector accounts for 62% of the island's greenhouse gas emissions. Mauritius nevertheless benefits from a strong exposure to green energy sources such as solar, wind and ocean energies. The country plans to 35% renewable energy by 2025, against 22% in 2020. In 2014, Mauritius's first solar farm opened in Bambous, and represents around 2% of Mauritius's energy mix. Cooperation projects around renewable energies and energy efficiency are multiplying in the Indian Ocean, particularly between Réunion and Mauritius, through cooperation agreements on sustainable development and energy management. For example, the two sister islands both value bagasse (residues of sugar cane stems) for energy purposes (bagasse provides 14% of Mauritius' needs). Be careful, however, of the crisis in the sugar industry, which could represent a limit to this system.

c) Smart city

In 2015 Mauritius launched the "Smart City Scheme" program, intended to create more than fifteen smart cities to respond to growing urbanization. A "smart city" is a
city that harnesses all new technological advancements to create work, living and leisure spaces that will be environmentally friendly, generate their own energy and water resources, provide connectivity and reduce traffic problems. However, it is difficult to guarantee that cities are truly environmentally friendly or inclusive: these projects, which require very high funding, are monopolized by the big sugar companies and other Mauritian conglomerates. Although constraints are set by the government, there is no monitoring or control of compliance with them.

d) The involvement of civil society

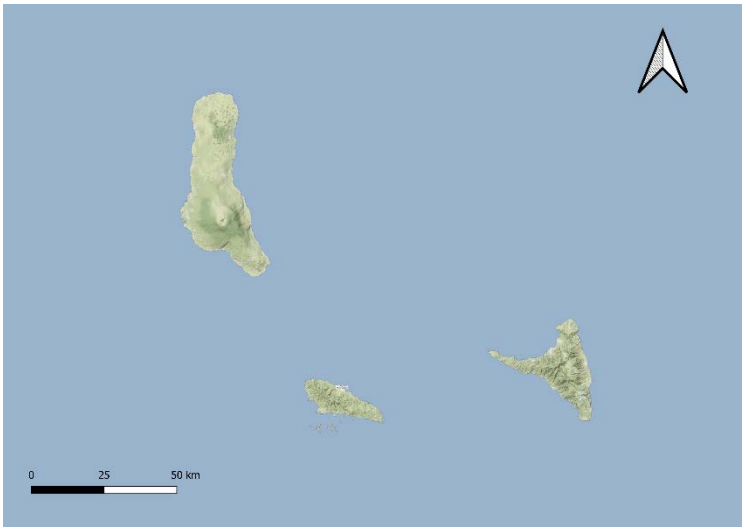
The national solidarity that spontaneously manifested itself to mitigate the disaster caused by the oil spill in 2020, ignoring the government's calls to stay away, was quite unprecedented and representative of a general awareness and interest growing population for the respect of the environment and the protection of their island. Many citizen initiatives are flourishing across the island, in particular for the protection of coastal areas and the biodiversity of the Mauritian territory, to improve waste recovery and raise awareness of the need to reduce waste or to move towards sustainable food. Two citizens' movements have also taken on a certain importance in the fight for the protection of the environment:

- "Projet de société", launched in 2017 at the initiative of Malenn Oodiah and which very quickly reached a large audience, offers real work of reflection and analysis around themes and issues related to environmental issues. RAeforestation projects (200,000 trees planted in 2018-2019) or preservation of marine biodiversity (100,000 corals to be replanted) have also been launched.

- The movement "Fridays for Future Mauritius", (resulting from the Fridays for Future movement initiated by Greta Thunberg) brings together young Mauritians sensitive to the danger of climate change and regularly organizes peaceful marches to raise awareness of the consequences of climate change and encourage a policy change on environmental protection.

1. https://www.thearda.com/internationalData/countries/Country_147_2.asp

THE UNION OF THE COMOROS



General presentation:

Archipelago of the Comoros: Grande Comore, Anjouan, Mohéli, which form the Union of the Comoros, and Mayotte, which is a French department. This fact sheet focuses on the Union of the Comoros.
Geographical location: Indian Ocean, south-east of Africa between the northern Mozambican coast and at the northern tip of Madagascar.
Independence: 1975 (formerly French)
Population growth: 2.4%

[1]	Urban Population	% pop urban	Number of cities	Population density	Population	Area (km2)	Population growth
GrandeComore	116 285 (73 868 à Moroni, the capital)	34%	10	376	381 859	1015	
Mohéli	26 195	53%	4	247	51 222	207	
Anjouan	95 296	29%	8	769	327 711	426	

The three islands of the Comoros, of exclusively volcanic origin, are characterized by a contrasting relief. Grande Comore, the most extensive, is home to Karthala (2361 m), the highest peak on the island and the last active volcano. The coast is low and very often rocky, and the island has a missing coral reef on almost half of the coastline. Mohéli Island, the smallest, is formed by a basaltic plateau spread out in the east, which rises in the west as a crest by Mount Kibouana at 765 m. The island is protected by a 2 km wide coral reef bordered by beaches and small mangrove bays. The island of Anjouan consists of a central nucleus, Mount N'Tingui (1595m), surrounded by three peninsulas. The relief of the island is very rugged with marked slopes, in particular because of the many rivers, perennial and temporary, which run through and which have carved out the island.

The Comoros has a very diverse coastal environment both in its morphology (low coasts, cliffs, islets, platinum, etc.) and in its nature (lava, black or white sand beaches, pebbles, boulders, coral reefs, etc.). The waters surrounding the archipelago also present a diversity of facies (rocky, sandy, muddy) and depths (from zero to several thousand meters) which have allowed the development of complex and original marine species and ecosystems. Mangroves form the boundary between the land and the sea and are also home to significant biodiversity, including endemic, rare and universally threatened species. Terrestrial ecosystems are just as diverse and constitute an original eco-region which falls within the humid tropical and subtropical forests. The Union of the Comoros is therefore a place of high priority intervention for the conservation of global biodiversity.

The Comoros benefit from a tropical maritime climate characterized by two great seasons: a hot and humid season, during which the rains are very abundant, (austral summer, "Kashkazi") from mid-November to mid-April and a season dry and cool, marked by the presence of the trade winds (southern winter, "Kuzi") from the beginning of June to the end of September. Two other off-season

[1] INSEED (2017) et Geoboundaries

wind regimes affect the archipelago: the "Matulay" and the "Mnyombeni". However, we note the presence of many micro-climates. These variations play an important role in the distribution of species, pedogenesis and erosion phenomena. There is also great diversity in rainfall within each island and between islands. The percentage of the population with access to drinking water is estimated at 30% in Ngazidja, 15% in Ndzouani and 80% in Mwali. Occasionally, the Comoros can also be crossed by cyclones.

The settlement of the Comoros is the result of successive migrations of groups of various origins (Bantu of Central Africa, Malays, Persians, Arabs, Chirazians, Pakistanis, Indians and Europeans). These migrations gave rise to a homogeneous population characterized by the same habits and customs, the same language, Shikomor (in addition to French and Arabic), and the same religion, Sunite Islam. The Comorian diaspora in the countries bordering the southwest of the Indian Ocean as well as in mainland France would be of a number equivalent to the population of the Comorian state2. This can constitute a real socio-demographic imbalance factor during sudden and massive returns.

With 42.4% of the population living below the poverty line3, the Comoros is one of the poorest countries in the world. The agricultural sector employs 80% of the working population (42.7% of GDP4) but is concentrated on only three cash crops (vanilla, cloves, ylang-ylang). The Comoros therefore remain largely dependent on the outside world and imported food accounts for 70% of total food consumption5. The private sector is underdeveloped and undiversified and faces significant challenges that prevent it from developing. add informal sector

Environmental issues

The country has experienced 18 disasters in the past 40 years, affecting half a million people, damaging infrastructure and agricultural land. In 2019, Comoros was hit by one of the most devastating cyclones in the country's history which affected more than 345,000 people and caused damage amounting to around 14% of GDP. Climate change and the destruction of natural coastal and marine habitats reduce their ability to protect against extreme weather events and exacerbate the already high risk of the Comoros.

The gap between population growth and the lack of change in management methods is a real threat to the country's biological diversity. Almost all arable land is already occupied6 and the only possible extension of agriculture can only come at the expense of the remaining forest areas. Some traditional unsustainable farming methods persist, such as slash-and-burn agriculture, the cause of uncontrolled deforestation (the archipelago has already suffered from the highest deforestation rate in the world between 2000 and 2010 (9.3% 7) The harmful consequences are numerous, such as the loss of cohesion of the soil which becomes vulnerable to erosion, leading to sedimentation along the coasts which in turn negatively impacts the corals as well as the coastal and infralittoral resources. water retention capacity within watersheds, which causes a cascade of negative effects for the resources they shelter, for the supply of water bodies and the supply of fresh water to the population. The Comoros are also facing coastal erosion, notably due to the uncontrolled extraction of sand from the beaches. s Comoros, where 88% of the population lives, could experience a 20cm rise in sea level by 2050, necessitating the displacement of nearly 10% of the population.

Coral reefs, which have recovered unevenly from previous bleaching phenomena, are today threatened, inter alia, by destructive fishing practices and the uncontrolled dumping of waste in coastal waters. Indeed, the absence of sustainable solutions in terms of waste disposal or recycling complicates waste management and negatively affects the environment as well as the health of populations.

Observations made in recent years at a few stations show a decrease in precipitation compared to normal rainfall as well as an upward trend in annual thermal averages over the same period. These data suggest that the Comoros could experience fairly severe droughts in the future, which would primarily affect agriculture, natural ecosystems and water resources.

Finally, given the limited industrial and urban development, there are not yet any heavy industries representing a significant risk of industrial accidents. However, the Comoros Islands being on the main route of the oil giants, the archipelago is exposed to a very high risk of maritime pollution from an accidental oil spill.

What priority areas for sustainable development?

a) Strengthening the territory's resilience in the face of disasters

Significant efforts have been made to strengthen the Emergency Preparedness and Response (SPR) system, but to date it is not yet fully operational. The response to the last cyclone made it possible to highlight the strengths and weaknesses of this system. Many affected households have benefited from community solidarity to rebuild their homes. However, given the absence of strong regulatory and operational frameworks in the housing sector, the government could not provide a reconstruction strategy early enough and many households did not use resistant materials or resilient construction engineering. The cyclone also highlighted the importance of long-term urban planning, sustainable and resilient development.

b) Planning and design of sustainable urbanization

Although the urbanization rate is currently quite low, it is increasing at a rate of 6.5% each year. The absence of a real spatial planning and city policy, and of means of monitoring compliance with urban planning standards, generate multiple problems: insufficient infrastructure and development services, strong land pressure, mainly in large cities, dilapidated road and sanitation networks, pollution of the shoreline and cities and the proliferation of illegal dumps, health problems linked to poor hygiene conditions, etc. Over the years, the percentage of the urban population living in slums has steadily increased (68% in 20181). The challenge is to organize the city and empower its stakeholders, in particular by strengthening the decentralization process and the capacities of municipalities, to promote sustainable urban development and strengthen urban resilience. Civil society organizations engage in small-scale development projects, trying to fill the voids created by lack of government action but still suffer from limited resources.

c) Preservation of the environment and biodiversity

The Comoros have ratified numerous agreements and conventions in favour of environmental protection. However, local authorities and local communities are weakly involved in environmental management projects. Sustainable tourism, for example, which the Comoros wish to develop, would have everything to gain from a greater involvement of local communities who can participate in the conservation and enhancement of socio-cultural values, in the conservation of biological identity and in development. good practices.

The Union of the Comoros benefits from programs and projects financed mainly by international organizations or NGOs. We can cite, for example, certain projects implemented by the World Alliance Against Climate Change: the creation of comics which aims to sensitize young people to better understand the challenges of climate change and to undertake ecological actions on a daily basis or even l management of the mangroves of Domoni Amboini to mitigate the effects of climate change. The French NGO Initiative de Développement is working for energy efficiency by creating a sector of thrifty cookers and thrifty distillers. The goal is to reduce to 50% the consumption of wood in households and distillers. It is setting up a reforestation campaign to meet the demand for wood.

Regarding waste management, many informal initiatives implement waste recycling solutions (paper bags and recovered fabrics, rugs made from plastic sandals, tablecloths from used textiles, etc.), which although modest in scope and volumes, testify to local dynamism and collective capacities. Construction waste is often reused for landfills or for new construction, further enhancing the potential for a viable recycling market. However, the introduction of regulatory parameters is

necessary to reduce the uncontrolled reuse of building materials which, when obtained from recycled waste, often reduces the structural integrity of buildings, thereby reducing their resilience.

d) Food autonomy

Agriculture and the environment are closely linked and have consequences for each other, both positive and negative (intensive agriculture harms the environment while rich soils cultivated in a reasoned and clean way can capture a large quantity CO2, for example). Sustainable agriculture must therefore be an integral part of any action plan for adaptation to climate change. The Germination project is a regional cooperation project which aims to better understand, conserve and enhance agricultural plant genetic resources, in order to ensure sustainable agricultural development and food security in the countries of the South West Indian Ocean. The NGO Dahari, a very active partner in the project, is taking part on the island of Anjouan in the promotion and dissemination of adapted local varieties and good practices for seed production and multiplication of healthy material.

e) The role of civil society

Civil society seems relatively weak in the Comoros. Traditional social structures still play a predominant role and most municipalities have at least one association (social, sports, cultural). Most organizations lack human, financial and technical resources and rely on organizations like Ngo'shawo (Movement of Conscious Youth of the Comoros), which is a key player and emphasizes the engagement of young people for the implementation. implementation of local development actions. We can also mention the platform for climate justice in the Comoros, which educates the Comoran population on the issues of climate change and sustainable development issues and wishes to facilitate the implementation of decisions on climate change and sustainable development, by supporting the activities of the Comoran State.

1. NSEED (2017) et Geoboundaries
2. https://www.cairn.info/revue-population-et-avenir-2012-3-page-17.htm
3. https://www.banquemondiale.org/fr/country/comoros/publication/latest-report-on-poverty-in-the-comoros
4. https://www.afdb.org/fileadmin/uploads/afdb/Documents/Generic-Documents/country_notes/Comores_note_pays.pdf
5. Sectorial note on agricultural policy. FAO, may 2013.
6. Grande Comores and Mohéli, the proportion of cultivated land in relation to the potential is 70%. It amounts to 80-90% for Anjouan (FAO / BM, 2013
7. According to the UN

MAYOTTE

General presentation

Geographic location: archipelago located in the Mozambique Channel and the Indian Ocean
Land area: 376 km2
Population: 279,500 1
Density: 690 inhabitants / km2 2
Population growth: 3.8% 3
Urbanization: 56.1%
Capital: Mamoudzou

The Mayotte archipelago, which itself forms the eastern part of the Comoros archipelago, is made up of two main islands, Grande-Terre and Petite-Terre, and around thirty small islets. Most of the population resides in Grande Terre (around 80%). The morphology of Mayotte is relatively complex: its coast is strongly indented, presenting many bays, peninsulas and points. Its relief is low, due to erosion and the sinking of its plateau, and its highest point rises to 660m (Mount Bénara). However, more than half of the surface of the island of Grande Terre is characterized by slopes of more than 15%. The Dziani Crater Lake and the Cavani Circus are remnants of the archipelago's ancient volcanic activity. With an area of over 1100km2, nearly 4 times its land area, its lagoon is one of the largest closed coral lagoons in the world. A true open-air aquarium, it houses 310 species of corals, 22 marine mammals, 750 species of fish and three types of reefs. In order to protect and better understand this heritage, the lagoon was declared a marine natural park on January 18, 2010. The Mayotte lagoon has a double barrier reef, a very rare geological phenomenon: the outer reef, which determines the limits of the lagoon, and the fringing reef. The outer reef stretches for about 150km, is 800 to 1,500 meters wide, 200 meters high, and is crossed by a dozen open passes to the ocean. The island of Mayotte is part of a global biodiversity hotspot and has exceptional natural resources, both terrestrial and marine: strong heritage flora, high endemic rate of species, tropical forests, terrestrial wetlands, mangroves, coral reefs ...

The climate of Mayotte is of the "humid tropical" type with two seasons. From November to April, the hot season, temperatures are high and the rainfall rate high (80% of annual rainfall). It is also the season for cyclones and tropical depressions, even though Mayotte is not exposed to the risk of cyclones, Madagascar serving as a natural barrier. From May to October, the dry season, the atmosphere is cooler, the humidity is lower, and the rainfall less frequent.

The settlement of Mayotte is the result of a historical interbreeding, between populations of Bantu origin and the different waves of immigration, mainly Madagascan. This mixing of populations can be explained by its geographical position, a place of passage and maritime transit. In 2004, the population was made up 59.4% of Mahorais, 22.5% of Malagasy, 11.9% of Comorians, and other groups of lesser size. In recent years, the island has had to deal with an illegal migratory flow, coming mainly from the Comoros but also from the Africa of the Great Lakes. The archipelago today presents a cultural and linguistic range, nevertheless largely dominated by the Swahili culture. It became French in 1841, French is the official language, but few inhabitants of Mayotte have it as their mother tongue and most of them (71%) speak Mahorais, a language of Bantu origin. The vast majority (97%) of tolerant Sunni Islam is practiced there, but the Mahorese culture is also imbued with animism and mystical rituals are still widely practiced, especially within the community of Malagasy origin. Christians are mainly metropolitan, Creoles from the Mascarenes or Métis.

Mayotte is now considered a DROM (Overseas departments and regions of France), although it does not hold the status of a region, but only that of a department. The Comoros nevertheless continue to claim their sovereignty over Mayotte, relying on UN resolutions condemning France's presence in Mayotte. The island remains the poorest French department, with 77% of the Mahorese

population living below the national poverty line. The economy of Mayotte is essentially based on agriculture / agrifood, fishing and aquaculture.

Environmental and social issues

Mayotte is the most deforested department in France, with an annual deforestation rate of 1.2%, similar to those of Argentina or Indonesia. While there were 11,000 hectares of forest in 1990, today only 5,600 hectares remain, to which must be added the 715 hectares of mangrove. This phenomenon is essentially linked to the often illegal practices of slash-and-burn cultivation. This deforestation is mainly located on private plots, outside public forests, which are therefore forests not subject to the forestry regime. This phenomenon has worsened with the COVID sanitary crisis and containment, due to the decrease in the presence of agents on the ground. In addition, the growing insecurity context limits or even prevents the effort to monitor and control public and private forests.

Soil erosion in Mayotte stems mainly from the impact of heavy tropical rains on poorly or unprotected soils: construction sites on non-building areas, non-vegetated embankments, tracks, bare soils in agricultural areas, unsuitable planting on soils steeply sloping, deforestation, etc. It has consequences both on the agricultural environment (sterilization of cultivated areas, drop in production) and on the urban environment (destabilization of buildings, mudslides, increase in the cost of maintaining infrastructure, deterioration of road networks. , water and sanitation) and on the lagoon (destruction of coastal ecosystems, decrease in fishery resources). This environmental problem therefore impacts the entire population living on the Mahorais territory.

In a context of strong pressure on water resources, in quantity as well as in quality, deforestation contributes to a decrease in rainfall and reduces the capacity of soils to retain water. In Mayotte, the drinking water supply comes mainly from precipitation water and surface water taken from rivers. The archipelago regularly experiences drinking water supply crises, in particular due to increased droughts and the increasingly late arrival of the rainy season. In addition, surface water or groundwater is increasingly polluted; rivers, in particular, are subject to garbage dumps, car washes, sewage, laundry, animal and human excreta. Although washing in rivers is now prohibited, the tradition continues and the products used, especially bleach, represent a serious danger to the environment and to health.

Waste management is another concern in Mayotte, where the insularity of the territory, the very high population density and the evolution towards a consumer society, make collecting, sorting, storing and recycling waste more complex. Indeed, Mayotte has only one landfill, on Grande Terre, and many illegal landfills are multiplying in natural areas, and waste is carried to the lagoon by runoff.

Mayotte's coastal environment, especially coral reefs, are among the most threatened in the Indian Ocean. The degradation of the lagoon, coastal areas and their ecosystems is mainly explained by the contribution of pollutants and sediments in the lagoon, the disparity of certain mangroves following the development of the coast or their use for agriculture, overfishing, mismanagement of tourism and leisure activities, and rising ocean temperatures. In 1998, 85% of coral populations died due to the high ocean temperatures reached during the southern summer (32 ° C). The coastline is also threatened by rising sea levels: in 2019, the island sagged six inches due to the formation of an underwater volcano off the island. The risk of submersion is aggravated by global warming.

Poaching represents a direct risk for the balance of ecosystems and the dynamics of natural resources. In Mayotte, poaching directly affects sea turtles, which are emblematic species of the region's biodiversity.

What are the axes of support for the sustainable development of the territory?

a) Protect forests and biodiversity

The Mayotte Forests Nature Reserve was created in May 2021, in addition to the Marine Natural Park created in 2010 and the M'Bouzi Islet National Nature Reserve, created in 2007. The objective of this reserve is to protect the natural islands of forests on the mountains and ridges of Mayotte and restore the functionality of the adjacent secondary forests. In total, the total area of the reserve represents 7.5% of the land territory and 51% of state and departmental forests. The decree regulates the activities that can be carried out in the forest and those that are prohibited. A reforestation plan meanwhile should make it possible to cover 150 hectares by 2023. Other initiatives can be cited, such as the LIFE4BEST program which supports a project of reforestation and the fight against invasive species, implemented by the Integration Service through Economic Activity of Mlezi Maore. The fight against invasive species has also resulted in the development in 2020 of the guide "Strategy for the fight against invasive plant species in Mayotte - Diagnosis and operational program of fight" by the Botanical Conservatory of Mascareignes and the National Office of forests.

In December 2018, the first list to identify all types of protected plant and animal species, often endemic, was formalized by prefectural decree. In total, they are nearly 470 to be the subject of a protective measure. However, to obtain the expected results, this list should be part of an educational and communication process.

b) Fight against soil erosion

The LESELAM project (Fight against Soil Erosion and Lagoon Siltation in Mayotte) sets up field experiments with the objectives of: understanding and quantifying erosion processes, identifying priority risk areas for put in place protection, prevention and remediation measures as well as the implementation of the urban strategy to combat soil erosion.

c) Develop the green economy

The weight of the green economy in Mayotte on all the companies present in the territory is very limited and does not exceed 1.0%, with only 16.8% linked to eco-activities. Green companies linked to energy production, environmental protection, as well as waste management and recovery, are still poorly structured but represent important growth levers and make it possible to respond to the ecological transition.

--The areas for improving waste management concern both their collection and their treatment. Faced with the dysfunction of the Syndicat Intercommunal d'Elimination et de Valorisation des Déchets de Mayotte, various associations are mobilizing to raise awareness among citizens and invite them to collect the waste themselves, even in the most remote places of the island. A study carried out by ADEME and Sidevam 976 estimates that more than half of the waste buried in the Mamoudzou landfill is recoverable. Currently, the waste sorting and recovery sectors are just emerging and are mainly the result of private initiatives, often supported by ADEME, which has been present in the region since 2007.
--The energy mix is 95% dominated by diesel. Given the low development potential of other renewable energy sectors, the photovoltaic sector constitutes one of the main levers for the development of renewable energies on the island. The development of the photovoltaic sector in Mayotte experienced strong growth between 2008 and 2011, with a doubling of the number of installations put into service each year, before running out of steam from 2012 following the national moratorium on the sector. . The installation of a storage unit for non-hazardous waste in Dzoumogné represents an opportunity for the production of biogas from household or similar waste.

d) Promote sustainable agriculture

Mahorais agriculture is mainly represented by subsistence and traditional agricultural systems called "Mahorais gardens". These farms, modest in size and family-run, constitute a real opportunity for preserving biodiversity and have a strong potential to contribute to the agro-ecological transition. Agricultural production in Mayotte is nevertheless today facing a decline in yields and soil fertility. Improving practices (erosion control, organic fertility, irrigation, pest management) is a major challenge in ensuring more sustainable systems. Established in Mayotte for twenty years, CIRAD supports the improvement and structuring of agriculture in Mayotte through research and training.

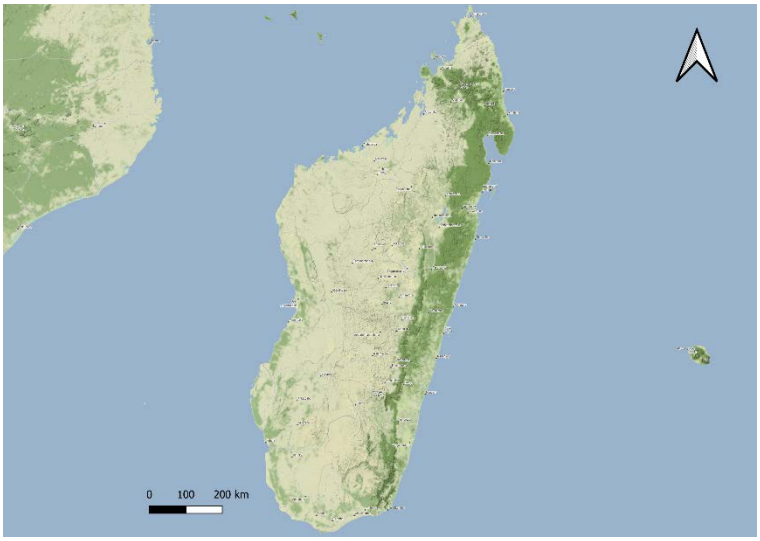
e) Strengthen the capacities of civil society

Two federations of environmental associations exist in Mayotte: Mayotte Nature Environnement (MNE) and the Mahoraise Federation of Environmental Associations (FMAE). MNE focuses its action more on the field of environmental education and regularly organizes awareness-raising or training events. The FMAE, for its part, rather supports village associations and their field actions.

Since the end of 2016, the French Committee of the International Union for the Conservation of Nature has been running, in partnership with the MNE and the FMAE, a training and support system for environmental civil society in Mayotte, a key player in the protection of biodiversity on the island but which faces certain development obstacles, such as access to financing or lack of experience in setting up a project. This project aims to strengthen the capacities of Mahorese associations to design, propose, finance and implement projects in the field of the environment.

1. 2020, INSEE
2. 2017, INSEE
3. INSEE

MADAGASCAR



General presentation:

Geographical location: Indian Ocean, 400 kilometers from the African coast, towards Tanzania and Mozambique
Area: 587,000 km2, 5th largest island in the world
Population: 27 million 1
Density: 46 inhabitants / km2 2
Population growth: 2.7% 3
Urbanization: 39% 4.
Capital: Antananarivo
Independence: 1960, formerly French

The Malagasy territory is divided into several zones. In the center of the country are the Highlands, which oscillate between 800m and 1500m and which cover 60% of the island. Almost half of Madagascar's population lives there. The western part is mainly made up of vast coastal plains which run along sandy beaches and the reef coasts of the west coast of Madagascar constitute the 5th coral reef in the world. The west is also home to dry deciduous forests which are home to large numbers of endemic plants and animals but which have suffered massive deforestation due to agriculture. In the east, the highlands turn into steep escarpments that lead to a thin coastal plain, made up of marshes and bordered by lagoons. Along the east coast lies 6 million hectares of tropical rainforest, which is among the most endangered forests in the world. The south is the land of the bush and large semi-desert areas. The northern volcanic region is isolated by the island's highest massif, the Tsaratanana (2,876m).

Madagascar is located between the zone of low equatorial pressures, to the north, and the Indian Ocean high pressure area, to the southeast. Due to its area and the variety of its reliefs, Madagascar experiences a tropical climate that differs from one part of the island to another. The Highlands have a mild climate (Mediterranean type climate); in the west, the climate is rather hot and dry; the east coast is rainy (rather equatorial climate); the south is semi-arid and it is hot and humid in the north. However, throughout the country, there is a dry season including the southern winter (April to October) and a rainy season (November to March). Tropical cyclones can occur at the end of the rainy season, between January and March. Finally, the trade winds blow over the country almost throughout the year.

Madagascar is considered a global priority in terms of biodiversity conservation and is part of the list of 17 countries established by the Nature Conservation Monitoring Center called "mega-universes". This list brings together the countries which hold the majority of species and are considered to be the richest on the planet in terms of biological diversity. In Madagascar, 98% of mammals, 91% of reptiles and 80% of plants found there are endemic.

Over time, Bantu, Indonesian, Arab, Indo-Pakistani and European immigrations have made up the interbreeding of the Malagasy people who now come together in 18 distinct ethnic groups. The national language is Malagasy, with variations according to the regions but understood by all. French is the second official language, but spoken by only 20% of the population. More than 52% of the country's population still practice the traditional religion which emphasizes the links between the living and the dead, around 41% of Malagasy are Christians, divided almost equally between Protestants and Catholics, and 10-15% are Muslims.

The ranking of countries according to the human development index places Madagascar 145th out of 181 countries, and the poverty rate calculated by the World Bank is 68.7%. The agricultural sector contributes 30% of the country's GDP and employs around 80% of the population, but is struggling to structure itself and fails to meet domestic food demand. The informal sector is gaining more and more ground in Madagascar: in 2019, according to the ILO 9 out of 10 jobs were in the informal sector.

Madagascar has experienced several periods of political crisis in recent decades that have marked the country and are felt on the daily life of the population, causing among other things a severe economic recession, problems of insecurity and development inequalities.

Environmental issues

Madagascar's natural capital, which represents more than half of the country's total wealth, is deteriorating year after year, threatening not only the ecological balance of the Big Island, but also economic, social and political. Madagascar has one of the lowest environmental indices on the planet and one in five deaths on the island is caused by environmental degradation and its effects on health.

Deforestation persists and only 10% of the original wooded areas remain. Its main causes are slash-and-burn agriculture as well as firewood harvesting and charcoal production. The volume of fuelwood consumed in Madagascar was 18 million m3 in 2015, the sustainable production potential of Malagasy forests being estimated at 9 million m3. Deforestation results, among other things, in the deterioration and fertilization of agricultural land, erosion, overexploitation of forest resources and depletion of water resources. Intensive logging linked to the production of charcoal and firewood also impacts mangrove forests, which are home to exceptional biodiversity, provide fishery resources and play an important role in climate regulation, thanks to their high carbon sequestration capacity. With 20% of forest lost between 1990 and 2010, these mangroves are among the most threatened in the country.

Indoor air pollution, caused mainly by the use of solid fuels (charcoal and firewood) has substantial adverse effects on human health. The burden of mortality and morbidity from indoor air pollution in Madagascar is higher than that from HIV / AIDS, diarrheal diseases and tuberculosis.

In recent years, illicit trafficking in natural resources has emerged as a recurring problem: indeed, due to their endemic nature, Malagasy wild species are highly prized on foreign markets, such as rosewood, land turtles, sharks, sea cucumbers and seahorses. All priority landscapes and seascapes are affected.

With 5,600 km of coastline, Madagascar has significant marine and coastal resources. Source of income for nearly 1.5 million Malagasy people, the fishing sector weighed nearly 7% of the national GDP in 2018. Nevertheless, overfishing, the resurgence of bad fishing practices and the general destruction of marine habitat (including mangroves) have led to a decline in coastal fishing in the region. The various fishing methods also endanger the biodiversity of coral reefs.

Industrial activities (mining, gas, oil) also have significant socio-economic and environmental impacts. For example, much of the Malagasy coastline of the Mozambique,
channel, which contains protected areas, community fishing areas, mangroves and coral reefs, has been leased for oil exploration. Legal and illegal mining operations also threaten protected areas in the east of the country by destroying their biodiversity and weakening the living conditions of the population, mining residues and other sediments strongly affecting the quality of river water.

Solid waste management systems in Madagascar are largely underdeveloped and more than half of the population does not have access to collection or disposal services and as a result, uncontrolled dumping is widespread. Landfills are increasingly saturated and pose serious health problems. In Antananarivo, for example, hundreds of tonnes of waste are dumped into the landfill every day without treatment, causing pollution of the atmosphere and soil.

Finally, Madagascar is considered the first country to face a famine directly linked to climate change, with more than 1.14 million Malagasy people currently suffering from hunger6. The scarcity of rains for four years has made farming almost impossible, and increasingly frequent sandstorms are destroying agricultural crops. In 2021, production drops were estimated to be around 40 to 60% compared to the average for the past five years.

What are the priority axes for a sustainable development?

a) Protection and rehabilitation of natural forests and mangroves

In 2020, the Malagasy government launched a vast project to reforest natural forests and mangroves, planning to replant 60 million trees per year. The aim is to fight against climate change and to sensitize and mobilize all the population who can take part in the initiative. However, reforestation is not enough on its own and must be coupled with actions to conserve natural forests and existing mangroves. Multiple projects are being carried out for this purpose in Madagascar, undertaken by the government, donors (AFD, BMZ, USAID) international NGOs (WWF, Good Planet Foundation, etc.) and local (ADAFAM, Antongil Conservation) or even grassroots community organizations. These projects include financial compensation, environmental education programs, support for the sustainable territorial management of resources or support for local development through sustainable economic sectors. Madagascar was a pioneer in the methods of experimenting with the involvement of local communities in the management of protected areas: the Gélose law of 1996 ensures the contractual transfer of natural resource management to local populations, structured in the form of organizations basic community. Thus, the contracts confer on the various local grassroots communities "the management of access, conservation, exploitation and development of the resources subject to the transfer of management, subject to compliance with the prescriptions and defined operating rules. in the management contract7". Regarding the sustainable wood energy sector, the emphasis is on the development of the production of green charcoal, training programs in more sustainable production techniques or on the promotion of the adoption of economical cooking equipment.

b) Fight against illegal exploitation of natural resources

Strong action and state commitment are essential to combat illegal logging in Madagascar. Control of logging operations and punitive sanctions must be strengthened against traffickers in natural resources. Madagascar is a member and signatory of various organizations and strategies8 to combat the illegal exploitation and illicit trade in wild fauna and flora, which offers it opportunities to seek financial and technical assistance internationally. USAID is particularly committed to this theme in Madagascar, and regularly funds projects implemented by consortia of NGOs (WWF, Wildlife Conservation Society, Conservation International, TRAFFIC, Durrel). These projects include strengthening the skills of forest guards and personnel assigned to protected areas in terms of their capacity to denounce illegal practices and identify the species concerned. In particular, a toll-free number has been created by the Voahary Gasy Alliance, allowing people to obtain information or report an attack on the country's natural resources. The AVG is a platform of 30 Malagasy civil society organizations, working for the establishment of good environmental governance in Madagascar.

c) Regulation of the environmental impacts of the extractive sector

If Madagascar has significant mineral and petroleum resources, the environmental impacts of extraction are increasingly important and the protest actions of local populations and civil society against mining and oil exploitation projects, in particular of unconventional oil, are increasing in intensity. The legislative framework is favorable to foreign investors and the public authorities have great difficulty in enforcing environmental obligations. The National Office for the Environment, responsible for granting environmental permits and monitoring projects, is sorely lacking in personnel, financial and material resources.

d) Establishment of a sustainable fishing sector

Coastal communities have an essential role to play in the sustainable management of marine and coastal resources. Within the framework of Locally Managed Marine Areas (LMMA), coastal communities use "dina", traditional and community regulations to manage natural resources in an efficient manner. Beyond simple conservation, the objective of LMMAs is therefore the sustainable management of resources through a participatory and inclusive governance system of user communities. Born from a community initiative, with the aim of ensuring peer learning and the sharing of good practices between communities, the MIHARI network now includes more than 200 LMMAs. International and local organizations (BM, FEM, PHRD, WWF, Blue Venture, Gret) also finance or

implement sustainable fishing programs which aim to improve the exploitation of certain fishery resources at the national and community level, to ensure the increase of the incomes of the local population who live from the practice of fishing or to sensitize the fishermen and to reinforce their ecological conscience.

e) Sustainable agriculture

Although Madagascar's agricultural potential is strong, yields suffer from soil deterioration caused by deforestation and the effects of climate change that weaken its ecological systems. Farming must therefore be done while preserving the natural capital of the island. Many pilot projects, most often funded by international organizations, focus on the development of more productive and sustainable agricultural systems and focus on technical support for farmers, improving access to agricultural services. irrigation and strengthening of the integrated management of natural resources in farming systems. Small local organizations are also getting involved in the subject, such as Green Art SOA, which develops ecosites, applying the principles of permaculture and agroforestry for ecosystem renewal. Urban agriculture projects also have their role to play: Antanarivo is one of the pioneer cities in urban agriculture, with agricultural land representing nearly 45% of its surface area, despite the strong demographic pressure of this agglomeration. of more than three million inhabitants. Even if it is decreasing in the city center, the agricultural area is increasing on the outskirts of Antananarivo. The production from this urban agriculture is for the most part consumed locally and involves 20% of households in the urban area.

f) Energy transition

The energy sector is saturated in Madagascar and can no longer keep up with the expansion of Malagasy cities. The country, rich in renewable energy sources, is gradually committing to an energy transition and projects are multiplying across the country, mainly financed by private developers or international organizations. Given the magnitude of the harmful effects of household air pollution, it is essential to introduce an alternative to charcoal ovens. The production of ethanol for domestic use, which is one of the least polluting gases, shows benefits in terms of health and reduction of deforestation and has been the subject of a national program for several years.

g) Sustainable urban development

In recent years, we can speak of an urban explosion in Madagascar where the urban population has increased ten times faster than the total population. Nevertheless, the rapid and relatively anarchic development of cities leads to problems of transport, planning, energy, sanitation, proliferation of unsanitary housing, etc. In 2012, about 88.2% of the urban population lived in slum areas. The national level is not always suitable for reflecting on and implementing effective coherent interventions at the local level, especially in the area of urban development. Planning tools have been put in place to reason on a smaller scale taking into account local realities. Currently, 59% of Regions and 5% of Rural Communes have their tools for participatory, integrated and sustainable planning. At the level of urban centers, 24 Master Town Planning Plans and 10 Detailed Town Planning Plans were approved from 2016 to 2020.

Large-scale projects are also funded by international organizations, such as the WB program, intended to improve urban drainage infrastructure, public services and resilience to natural disasters in poor neighbourhoods in Greater Antananarivo.

1 INSEE, 2019, https://www.insee.fr/fr/statistiques/4277591?sommaire=4318291
2 ildem
3 World Banque
4
5 SNABE 2018
6 accordinfg to the UN
7 GELOSE law, supra note 1, art 43
8 CITIES, OIBIT, LEAP,

SEYCHELLES

General presentation

Geographical location: 115 islands divided into 5 archipelago, scattered over 388,500 km2 in the Indian Ocean, north-east of Madagascar
Land area: 444 km2
Population: 97 625 1
Density: 212 inhabitants / km2
Population growth: 0.85% 2
Urbanization: 57.5% 3
Capital: Victoria, which is located on the main island of Mahé
Independence: 1976 (formerly dependent on the United Kingdom)

The Seychelles archipelago is organized into two main groups: the inner islands and the outer islands. Of the entire archipelago, only 33 islands are inhabited. The 43 inland islands are predominantly granite and generally distinguished by a mountainous centre, rolling hills covered with tropical trees and a thin coastal plain. The main island, Mahé, is home to the Morne Seychellois (905m) which makes it the highest granite island in the world. Although they represent only 54% of the area of the Seychelles, the granitic islands (notably Mahé, Praslin and La Digue) concentrate 98% of the population. The outer islands include the 72 coral islands which appear as atolls. These islands are flat and their emerged part, resting on coral reefs, does not exceed a few meters in altitude. The few inhabitants live there from agrarian activities, or are protected under the aegis of national parks. Everything opposes the granite group of the coral group: relief, vegetation, population density, economic importance, etc.

The Seychelles territory is 99.97% made up of aquatic surfaces: with its EEZ, the 25th largest in the world, this country governs 1,300,000 km2 of ocean. 30% of these territorial waters enjoy a protected status (the world average is 11% according to the United Nations).

The climate of Seychelles is equatorial, with a dry and cool season (April to October) and a hot and humid season (October to March) not very marked. While the northern islands have a more rainy climate than those in the south, the rainfall pattern is quite irregular from year to year because it is affected by the ENSO cycle. The Seychelles archipelago, which lies off the hurricane route, is usually untouched by hurricanes, with a few exceptions.

Nature is the most precious asset of the Seychelles archipelago and with a large number of endemic species and geological elements, the island state is part of the biodiversity hotspot of the Indian Ocean Region, in particular 275 bird species, 2,000 plants, of which 75 are endemic, and almost more giant tortoises than inhabitants (95,000). Seychelles has the highest proportion of protected areas in the world: in 2018, 42% of the land area of the archipelago was protected and classified as a nature reserve4. Seychelles is also home to two UNESCO World Heritage sites: the Vallée de Mai, in Praslin, and Aldabra, the world's largest elevated coral atoll.

The late settlement of the Seychelles (from the 18th century) provided ideal conditions for the protection of its unique ecosystem. Indeed, it was not until 1770 that the first French settlers settled in Mahé. They were mainly impoverished settlers from Mauritius and Réunion. Deported slaves from Madagascar and the African continent also arrived. Shortly after, the neighbouring islands were also colonized. The French heritage still predominates today, which is reflected in particular through the French language, which forms the basis of Creole vocabulary and grammar. In 1814 were integrated

into the British Empire. There is thus a great cultural diversity among the Seychellois population, the multi-ethnic roots of the inhabitants extending from France to India,
the UK, China, the Arab world, as well as other parts of Africa.

Catholics represent 80% of the population, followed by Anglicans (8%), Hindus (2%) and Muslims (1.5%).

Seychelles has the highest GDP per capita in Africa and is ranked among the upper middle income countries. Its economy is mainly based on tourism and the export of fishery products, two sectors that could be strongly impacted by the consequences of climate change.

Environmental issues

With 86% of its global population living on the coastlines, the Seychelles are highly exposed to natural hazards linked to the sea, and in particular to submersion and erosion. Indeed, the Seychelles are strongly threatened by the rising waters and many of its atolls risk disappearing in the coming decades. Warming oceans and melting Antarctica are also impacting the granite islands, which risk being rendered unlivable for the population. The ocean which absorbs heat and CO2 increases in temperature and becomes more acidic, causing bleaching and destruction of sensitive coral reefs. Since the 1990s, recurrent phenomena of coral bleaching (notably el nino, which in 1998 led to an unprecedented and lasting rise in the temperature of the surface of the Indian Ocean) have resulted in the loss of almost 90% of the coral cover of the archipelago. The corals can no longer fulfil their role of natural barrier and the waves intensify and break more and more often on the coasts and accentuate erosion. The disappearance of corals also has consequences on marine ecosystems, depriving of food and habitat an important marine fauna of various species, thus modifying their migratory route. The diversity of fish species has declined by 50% in the hardest hit areas. Less biodiversity weakens the ecosystem by making it less stable, and the scarcity of certain species of fish can have lasting effects on the food chain. The extinction of corals and the migration of fish therefore threaten the ecosystem of the islands but also the livelihoods of the population, impacting the two major sectors of the Seychelles economy: tourism and fishing. The Seychelles marine and terrestrial ecosystem is also threatened by invasive species, which in recent years have been a growing concern for conservationists and environmentalists in Seychelles, where they are perceived as the primary factor in species extinction and transformation ecosystems.

The management of stocks of maritime resources is a key issue for Seychelles, which must ensure the viability of the industry. In Seychelles, overfishing is compounded by the increase since the 1990s in the use of Fish Aggregating Devices, a particularly devastating fishing method. Increased catches of juvenile fish as well as bycatch of non-target species are some of the problems associated with the use of FADs. In addition, lost or abandoned FADs damage coral reefs as well as marine species such as sea turtles which can often get caught in nets and drown.

If the Seychelles are not located in a so-called cyclonic zone, because they are too close to the equator, the rainfall and stormy episodes resulting from these climatic events nevertheless reach the archipelago, which is particularly vulnerable to floods and landslides. Climate change is at the origin of the intensification of many climatic phenomena and could increase the vulnerability of Seychelles to these bad weather. As the country is little exposed to cyclonic risks, constructions and buildings are not up to standard, which could pose a problem if hazards of this type began to hit the territory. The El Nino and La Nina climatic phenomena, which originate from a significant temperature anomaly in the surface water of the South Pacific Ocean, have already shown in the past the Seychelles' vulnerability to extreme climatic phenomena. The events of 1997-1998 and 1998-2000, in particular, had very significant negative economic effects. They are considered responsible for 45% of losses in the fishing sector over the period, 28% for agriculture, 12% for tourism, 7% for industry.

The supply of drinking water is also threatened: water resources depend mainly on rivers, groundwater and seawater desalination. Water stress could increase in the coming years due to the increase in intensity. and irregular rainfall (increased runoff and reduced water uptake), comparatively longer dry seasons and increased temperatures (hence evapotranspiration).

Finally, if the Seychellois state depends on tourism, the growing increase in the number of tourists represents a major challenge for the archipelago, which wishes to protect itself from mass tourism and the environmental impact it can represent. New tourism infrastructure construction projects are also contested by the population or local NGOs, such as the new hotel project on the island of Mahé initiated in early 2021.

Seychelles, a global model for the preservation of the environment?

Seychelles is often cited as an international example of environmental conservation and as a pioneer of the blue economy. Sensitized to the impact of global warming, the archipelago is an active state and regularly alerts the international community to the urgent need to act.

a) Maritime spatial planning

Launched in 2014, the Maritime Planning Initiative aims to help strike a balance between increased demand for human activities and the need to protect marine ecosystems. Through a complete, public and participatory process, it identifies and sets out the main management guidelines and deals with the activities authorized in the entire exclusive economic zone. Completed in 2019, this is the first comprehensive and large-scale marine spatial planning plan in the Western Indian Ocean, one of the first for a small island developing state, and the largest plan to development of the marine space in the world, after that of Norway. While in 2017, only 1% of Seychelles' maritime areas were protected, the country created in 2020 one of the largest marine protected areas in the world, covering 30% of the country's territorial waters. The new protected areas are divided into two zones: the first, an area of high biodiversity protection, is a “no take zone”, where almost no human extraction activity is allowed. The second zone is an area of protection of average biodiversity and sustainable use, designed to conserve natural ecosystems while allowing certain economic activities, in particular fishing, tourist charters or even renewable energies, with new regulations nevertheless. The work of designating these marine protected areas and the drafting of "authorized activities" was the subject of a large-scale participatory process with the organization of about fifty workshops.

b) Coastal space planning

Faced with the vulnerability of their coasts, the Seychelles developed their first coastal spatial planning plan in 2019, with the support of the World Bank. This plan identifies the various measures to be implemented in order to ensure the resilience of the coastal space and the good health of ecosystems while encouraging sustainable economic development of the coasts. It is within this framework that Seychelles is exploring a natural “blue barrier” solution, which involves the construction of a submerged structure using natural non-toxic materials, designed to induce breaking waves, reduce or redirect sea currents. destructive erosion, and facilitate the colonization of corals.

c) Restoration of corals

In 2010, Nature Seychelles launched the Reef Rescuers Project on Praslin Island, funded by USAID and GEF. This coral restoration project aims to repair damage caused by coral bleaching at selected sites around Praslin and Cousin. After 10 years of coral restoration, Nature Seychelles has raised more than 50,000 corals in its underwater nurseries, With new corals planted on more than 5,000 square meters of degraded reef in the marine reserve of the island's special reserve Cousin, this is the world's first coral restoration project of this magnitude.

d) Promotion of the blue economy

The blue economy is a concept created in the 2010s, which concerns economic activities related to oceans, seas and coasts, respectful of human rights and the environment. This model takes up traditional activities, such as the reasoned management of fisheries, sustainable aquaculture, green maritime transport, ports, sustainable tourism but also emerging areas such as renewable energies,

marine ecosystem services, desalination, etc. In just a few years, Seychelles has established itself as the champion of the blue economy on the international scene. The archipelago is notably a pioneer in terms of financing innovations for the blue economy. In 2018, the country launched the world's first "blue" sovereign wealth fund, which mobilizes 15 million euros to fund an investment fund and another for managing grants, which respectively offer loans at low interest rates or donations to project leaders linked to the blue economy or to combat climate change. Seychelles also became the first country in the world to have gone through the protection of nature as a mode of debt repayment: the financing and creation of the two marine protected areas was made possible by an agreement concluded in 2016 between the government Seychellois and the American NGO Nature Conservancy, relating to the purchase of 17 million euros of public debt in exchange for the creation of these two marine protected areas.

e) Sustainable tourism

Tourism and environmental conservation are closely linked in Seychelles and the latter wish to become a global model for sustainable tourism. The Seychelles' global reputation for preserving the environment attracts tourists, who are both essential to the economic development of the archipelago but also pose a risk. The Seychelles Sustainable Tourism Foundation strives to make the country an example of international good practice in sustainable tourism through an integrated collaborative approach between the public and private sectors, academia and non-governmental organizations. In 2019, the organization was also elected a member of the regional council of the United Nations World Tourism Organization.

f) Involvement of civil society

Environmental protection is embedded in Seychellois culture. For example, elementary school students follow training courses delivered by local NGOs in eco-schools, where they learn the basics of recycling, ocean protection and endangered species. Children are also involved, alongside many volunteers, during shoreline clean-up operations. There are many local NGOs dedicated to environmental protection and public awareness: The Green Islands Foundation, The Ocean project Seychelles, Nature Seychelles, The Marine Conservation Society Seychelles, etc.

Cousin Island also became the first island in the world purchased for the conservation of a species. Cousin was actually bought in 1968 by the NGO Birdlife International in order to save the Seychelles reed warbler from extinction. Since then, native vegetation has reclaimed its rights, the reed warbler is rescued and Cousin Island has become the most important nesting site for hawksbill turtles in the western Indian Ocean.

1. 2019, BM
2. 2020, BM
3. Idem
4. https://knoema.fr/atlas/Seychelles/topics/Environnement/Biodiversit%c3%a9-et-zones-prot%c3%a9g%c3%a9es/Aire-terrestre-prot%c3%a9g%c3%a9e?mode=amp

Preparatory round tables : La Réunion

"Réunion in the face of climate change: Perception and the collective management of risks"

Round-table discussion 1 – 06 July 2021

Réunion Island is one of the French departments most exposed to the risk of natural disasters due to its distinct relief, its geology and its geographical position. In addition to the issue of natural hazards, there is the uncertainty linked to climate change and human activity, which increases the vulnerability of certain areas. This situation tends to increase risks; however, there does not seem to be a correlating increase in the perception of risk as there have been no recent disasters that could possibly affect people's attitudes.

Since the vulnerability of environments depends on the actions of many actors (citizens, companies, institutions, etc.), how can awareness of this issue be raised? How can the perception of a threat be transformed into a commitment by the actors concerned? How can collective risk management be envisaged?

This round-table discussion drew on examples of coastlines and their management, and brought together representatives from the territories concerned, researchers and project leaders to share their experiences and debate the issue.

Guest speakers:

- Vayana Dominique and Marina Tomadin, Project managers for the preservation of aquatic environments, Project managers for the Gestion Intégrée du Littoral et de la mer des Territoires de la Côte Ouest.
- Frédéric Floricourt, Mission Gestion des milieux aquatiques et la prévention des inondations, Eau et Assainissement, Communauté Intercommunale des Villes Solidaires – Le cas de l'étang du Gol.
- Amandine Junot, PhD in Social and Environmental Psychology at the University of Réunion – The drivers of environmental commitment.
- Jaëla Devakarne, Coordinator of the Isopolis project, which aims to bring together societal innovations based on resilience on the island.

The experimentation of Gestion Intégrée de la Mer et du Littoral (GIML, Integrated Management of the Sea and the Coast) for the West Coast territory

The GIML project was carried out by the TCO, the Communauté d'Agglomération de la Côte Ouest de la Réunion, in 2013, in a territory that offers a pertinent example of a fragile and complex area with a variety of actors and issues (the watershed of the Saint Gilles ravines). This project responded to the need to create a coherence between the various maritime and land policies, while also improving the management of the land–sea continuum by breaking down thematic and institutional barriers in a process that involved the co-construction of tools and methods that would encourage the mixing of "learned and lay knowledge" necessary for the preservation and sustainability of the socio-ecological systems of the territory.

Through a participatory process, the collaboration of the actors allowed for the construction of a "shared diagnosis", the keystone of the approach. This was followed by a prospection and scenarization phase, which ultimately led to the elaboration of a strategy and an integrated action plan consistent with the objectives expressed by the actors for their territory. Its implementation is based on three so-called "medium" axes, namely the development of cross-sectoral and participatory governance methods, increased and targeted communication and awareness-raising, and, lastly, improved levels of knowledge and monitoring sustainability.

Evaluation and outreach tools (project evaluation grid, cartographic atlas, documentary database, network directory) have been made available to project leaders and the general public. In addition, several awareness-raising actions, with an encouraging impact, were conducted such as the "total art performance", an educational and cultural mediation project for schoolchildren.

Sustainable development and the role of the citizen: An entry point through environmental psychology

Environmental psychology studies the mechanisms of interrelations between individuals and their environment. By understanding them, it becomes possible to optimize and direct them towards a degree of sustainability. To do this, it is necessary to look at the socio-cognitive, emotional and motivational determinants and processes at the source of behaviour, but also at the specific environmental conditions that contribute to the well-being of individuals, a "key condition for commitment". This leads to the notion of congruence as an objective of spatial planning, placing the quality of life and the satisfaction of people's needs as the basis for facilitating the sustainability of a project.

The perception and representations that individuals have of their environment is an important factor of congruence. In Réunion, the attachment to a nature that is both dense and varied, accessible and has a certain landscape quality was identified quite precisely, and is anchored in the very identity of the territory and its inhabitants due to the significant ruralization of the area. All of these "green places" are privileged spaces for the population to socialize and exchange.

In order to encourage individuals to take up the environmental cause, it may be wise to promote projects, measures and actions that encourage an attachment to the place, in particular through "passions" linked to behaviours of commitment and personal identification (education, enhancement, etc.), which would enable individuals to be independently motivated. And this would replace an often restrictive approach (internal and external pressures, sanctions, controls, etc.) that contributes to less frequent and lasting behaviour.

This presentation is based on the thesis work of Mrs Amandine Junot, "Encouraging pro-environmental behaviours: Passion as a motivational force for the environmental cause".

The case of the Etang du Gol: Between social and environmental issues

The Etang du Gol and its watershed cover an area of 96 km^2 and are subject to pressures linked to both human activities (illegal dumping, poaching, agricultural practices, etc.) and natural pressures (flooding of the lake, coastal submersion, etc.). Located in the two communes of Saint-Louis and Etang-Salé, a multiplicity of actors and regulatory levels are involved in its management, development and exploitation, sometimes with contradictory objectives.

The CIVIS, the contracted manager of the Conservatoire du Littoral, has initiated a management plan which has already enabled the deployment of actions integrating various environmental, economic and social issues of the territory. Taking an inter-communal approach, it aims to protect the quality of the water and the biodiversity of the lake through the following actions, which are currently being implemented:

- The identification of "good functioning areas" of the wetlands of the Etang du Gol and the Saint-Etienne River for the establishment of the Green and Blue Framework;
- The creation of a Lake Contract bringing together all the stakeholders of the site within the framework of the SAGE;
- Actions to reconstitute natural environments (campaign against terrestrial and aquatic invasive species, awareness raising, waste collection, etc.).

With a view to linking the preservation of the environment with the economic and social issues of this region, known for its high rate of unemployment, work is underway with key players in the employment sector. The CIVIS is considering and undertaking actions to establish a local presence, by involving both economic stakeholders and the population as a means of creating a common vision

of the constraints linked to the environment (sponsorship, professional training, educational projects in conjunction with the national education system).

Isopolis: Towards a resilient societal model

Societies today are marked by fractures at multiple levels (individual, social, ecological, organizational, etc.), which increase vulnerabilities and fragilities as highlighted by the COVID crisis. Based on this observation, the Isopolis experimentation project aims to foster the transformation of the current societal model towards a resilient model that supports the happiness of the people of Réunion.

The project is currently in its "Gamma" phase, in which a co-construction process organized around three interacting functions is beginning:

- Territorial co-construction: Around this central notion of resilience, four 'worlds' or groups of actors taking part in the governance of the territory – research, the economic world, public action and civil society – will be brought together. Each of them has its own codes and a different way of considering, classifying and managing societal issues. Isopolis has thus built tools to help structure these issues by simplifying them on the basis of five scales of resilience (individual, organizational, cultural, food and ecological, and territorial).
- Experimentation: With a view to moving away from intellectual analysis towards more inclusive and unifying fieldwork that is conducive to the establishment of a culture of impact, societal innovators from civil society will conduct exploratory pilot experiments.
- Knowledge and its management: These two main functions will be assisted by a team dedicated to the capitalization and mutualization of territorial engineering (deployment of a territorial knowledge system).

The debate:

"An important subject in Réunion, the coral reef – today, in poor condition – plays a very important role in the protection of the coastline, a real bulwark against cyclones. […] What concrete actions can be taken to control the transfer of water to the marine zone?" Pascal Talec (DEAL Réunion)

"How will climate change and future cyclones modify the territories, whether physically or by affecting the population and economic activity? […] We are beginning to have diagnostic tools on exposure, in order to see where policies should be focused". Sabine Garabedian (economist at the University of Réunion, RenovRisk project)

"How can the issue of culture be integrated into the way we communicate with people, and in the way we respond to their needs in particular?" Jaëla Devakarne

"Réunion in the face of climate change: Land pressure and housing patterns"

Round-table discussion 2 – 24 August 2021

In a constrained territory, which is home to an important national park (national biosphere reserve), only 1,000 km² of land are considered "useful" or capable of hosting human activities. Within this space, more than 300 km² already form the urban area.

Even though the relationship with the land, which is rooted in Réunion's customs and way of life, is a means of being attentive to one's environment and contributes to the collective awareness of the need to conserve and maintain healthy natural ecosystems, it seems more difficult than ever to offer everyone a "kaz atèr" in the context of the island's demographic growth.

Faced with increasing land pressure, how are stakeholders positioning themselves? What approach is being proposed by public authorities? How are these issues perceived by civil society project leaders?

With growing land pressure, tensions are obviously exerted on the coast, but also increasingly on agricultural land and towards the Hauts. How can the space be occupied without endangering the island's biodiversity? How can the inhabitants be protected from the risks present and known in many parts of the island?

Guest speakers:

- Michel Watin, anthropologist.
- Ariste Lauret, Deputy Director General of the SAFER (Société d'Aménagement Foncier d'Etablissement Rural).
- Léo Kichenassamu Alamelou, Project Manager of the Citizen Transition Pact in Sainte-Marie.
- Hatim Issoufaly, Association Riz Réunion.

As well as representatives from the workshop territories: Réunion Region, CIREST, CIVIS and the commune of Saint-Louis.

Understanding Réunion's current housing and lifestyle patterns – Michel Watin

The departmentalization of Réunion Island in the 1970s led to major transformations in the territory and its society. This multi-level development brought with it values and an ideology of "Western-inspired modernization" which clashed with the existing model directly inherited from the island's colonial past. Two distinct "ideal/typical" models of living arrangements thus emerged, reflecting the different ways in which public and private spheres were divided in Réunionese society. On the one hand, there was the "La Kour" model, in which the domestic space is crossed by the private/public boundary and which is inscribed within the notion of the "Kartié" (the organic unit of Creole society in terms of its geographical, genealogical and economic dimensions). On the other hand, there was the model of "La villa", a domestic space of metropolitan inspiration, where the private/public boundary surrounds and merges with the physical limits of the property, the grouping of which defines a "neighbourhood", a mono-functional geographical space.

Contemporary ways of living are combinations of variable elements (context, individual and collective objectives and socio-professional categories of individuals), situated on the continuum bounded by these two models. As such, a "Réunionese modernity, a reinterpretation of the Western house in the tropics" has emerged and continues to develop.

Competition for the use of the territory's spaces – Ariste Lauret

In a context of demographic growth and urbanization, the territory, which is limited in space due to its size, its relief, but also the presence of an exceptional nature to be preserved, is facing a real problem of competition for use between agricultural, urban and natural lands. The need for housing, which until now had been expressed by the development of traditional models of the garden city and

the "kaz atèr", requires considerable space and is in conflict with a growing need for food and therefore for space dedicated to agriculture (only 480 m^2 of utilized agricultural area per inhabitant). Can this traditional way of living survive in the face of current constraints?

To respond to this problem, actions have already been implemented by local players such as the Société d'Aménagement Foncier et d'Etablissement Rural (SAFER), a public institution that encourages the creation of activities in rural areas: protection of agricultural land and reclamation of uncultivated farmland through the "Terres Incultes" (uncultivated land) procedure, the prevention of agricultural land division through the Commission Départementale d'Aménagement Foncier (CDAF), and the development of niche agricultural sectors. How can national and European directives and tools be better understood and adapted?

Citizen Transition Pact: Making the link between civil society and the political and institutional world – Léo Kichenassamu Alamelou

The Citizen Transition Pact is a tool to inspire and support inhabitants and local elected officials to work together for more ecological, supportive and democratic communes. It is being implemented in Réunion on several levels. Firstly, at the regional level, through the signing of a Regional Transition Pact representing some forty measures addressing various themes, including in particular the development of participatory housing and eco-cities accessible to all. This is embodied in measure number 15, with the idea of encouraging the emergence of new projects, raising awareness of participatory housing, and also supporting current projects, particularly those involving the transition of existing buildings towards eco-villages. Secondly, at the communal level, with roughly twenty communes that are currently involved in a Transition Pact consisting of 32 measures. "The idea is to call on all citizen movements to contribute to the construction of this new Réunionese society, which is also learning from its past."

Riz Réunion: Building a coherent and sustainable agri-food sector – Hatim Issoufaly

As a citizen's initiative, the Riz Réunion association is working towards the reintroduction of rice cultivation to the territory, as it is the basis of the local culinary culture, but which currently represents 43,000 imported tonnes each year. This new production would respond to ecological concerns related to its transport; economic concerns through the reduction of import costs and the creation of employment and wealth; food security, particularly in the context of the global health crisis; and also ethical concerns in terms of coherence and sustainability.

In this regard, the association builds and promotes a free and open technical and social model of rice cultivation where each person with a plot of land can start his/her own production, in a dynamic of reclaiming the space to feed his/herself. Riz Réunion accompanies and trains people in cultivation techniques while providing seeds and access to the necessary tools (irrigation and hulling machine). The aim of the action is to ensure the sustainability of a complete chain of production, from production and consumption to processing. At the same time, the association carries out important awareness-raising and educational work with consumers, and in particular with schoolchildren.

The debate:

Public space in Réunion is more akin to collective or common spaces, which find their place within the "Kartiés". The right to the city is played out within the urban public space, which must function as a civic space, a vision that is beginning to permeate mentalities.

How do we talk about the right to the city in Réunion?

How can the expression of Réunion's cultural identity be guaranteed in urban spaces while respecting the aspirations and values of each individual?

Collective housing, and particularly social housing, was originally very rudimentary, but over the years it has been transformed from a technical point of view towards greater comfort. However, the process

of Creolization that began in the 1970s has struggled to effectively adapt to the specific Western ways of living that social housing requires. Today, the wear and tear that can lead to the indecency of infrastructures within the public and private housing stock, coupled with this lack of cultural coherence (lack of intimate spaces and nature), pushes individuals to strongly favour areas outside of the city (the mid-slopes), even if this means sacrificing technical comfort.

How can the need for nature and the "outdoor life" of the Réunionese be better reconciled with urban space?

Is it a political responsibility to make cities more attractive in the face of densification?

In the current context, how can we build in a way that is coherent with environmental (zero net artificialization, soil permeability, preservation, etc.) and ethical (dignity, quality of life, etc.) concerns?

Among the existing initiatives, projects for the creation of shared gardens have been set up in various communes. However, the island's populations have difficulties in appropriating them, again because of a Western-inspired model that is not compatible with the specific context of Réunion. The lack of support, particularly within social housing, is identified as a factor limiting the development of these gardens. However, some of them have met with real success, contributing to the individual and social well-being of their neighbourhoods (by SEMADER in Tampon, the association "Bien Vivre à Fayard" in Saint-André).

Also, the establishment of eco-districts, like shared gardens, is still a recent trend in the territory. Their relevance and sustainability remain to be seen. It seems appropriate to structurally integrate the Creole model of the extended family as a social base.

How can these new models of living together be adapted to the territory and its specificities?

How can the different types of usage be understood in terms of the various groups?