



WAGENINGEN  
UNIVERSITY & RESEARCH

# BONAIRE 2050

A NATURE INCLUSIVE VISION

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OUTLOOK

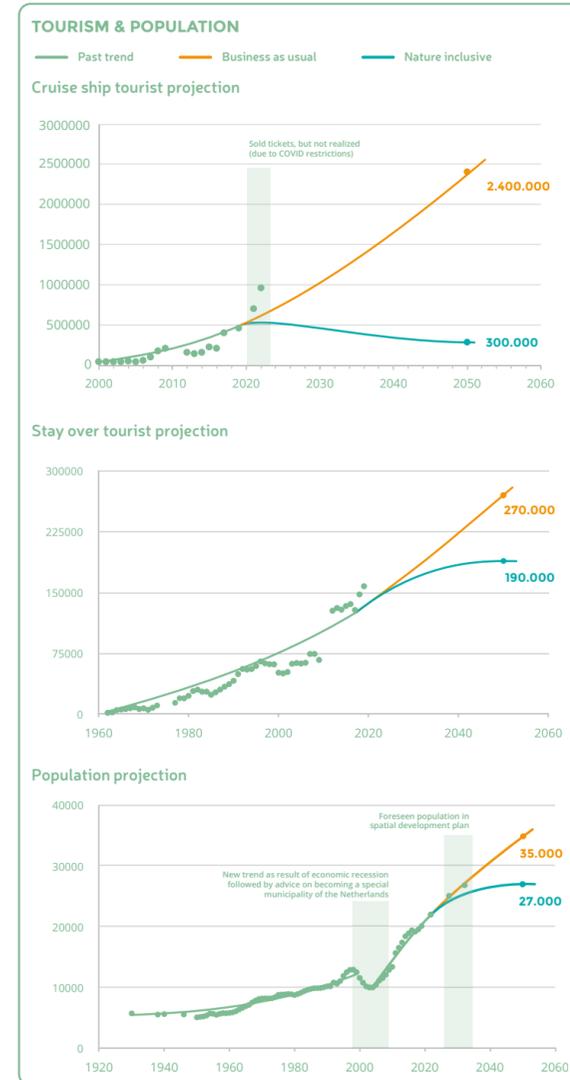
# BUSINESS AS USUAL ON BONAIRE

This is a snapshot of Bonaire in 2050 if historical trends continue at the same rates as in the recent past in terms of urban and tourism expansion and island policies.

The population on the island is double that of today. The numbers of cruise ship tourists have increased almost fivefold, and the built-up areas is expanded to accommodate for this. The energy demand has tripled and the water demand has nearly doubled. Meanwhile access to freshwater is increasingly difficult and costly with the drier climate.

The free-roaming grazers continue to remove vegetation, which further dries-out the landscape. The ongoing expansion of the town makes it increasingly susceptible to flooding and land wash-off. The land becomes less and less fit for growing food and the dependency on off-island imports continues. This dependency makes the island susceptible to fluctuations in world trade and market prices. The shorelines are being further built up, forming a continuous wall of constructions, which in turn threatens the touristic appeal of the island.

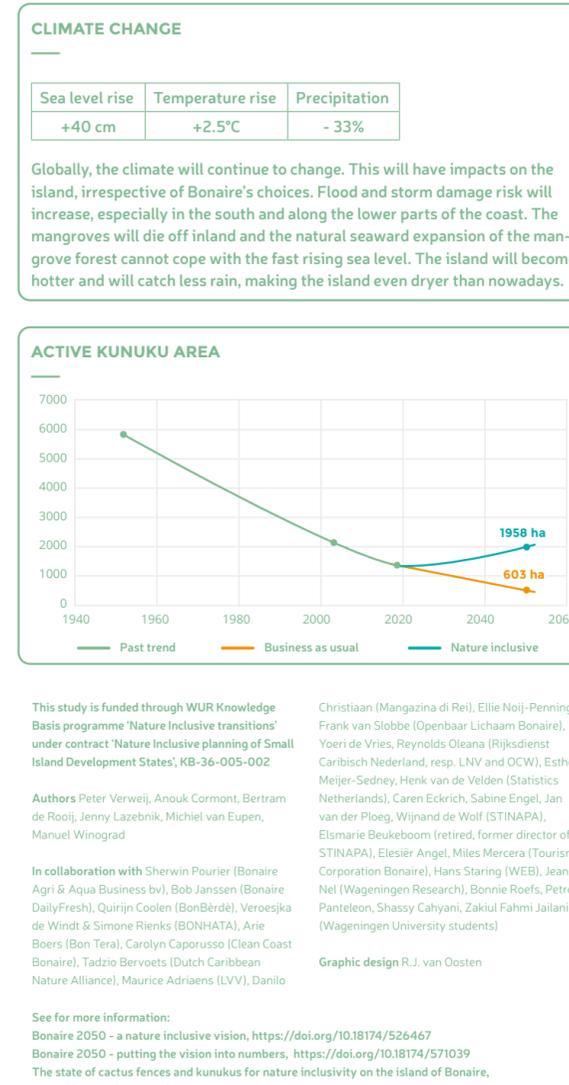
On the inside of this fold-out, two possible futures for Bonaire are portrayed. They help think how the future might look like, what is desirable and how to reach such a future. These images of the future result from a series of design sessions, interviews and workshops with local experts, decision makers and researchers, underpinned by scientific data and field observations.



## BUSINESS AS USUAL ON BONAIRE



## NATURE INCLUSIVE BONAIRE



OUTLOOK

# NATURE INCLUSIVE BONAIRE

This is a snapshot of Bonaire in 2050 if island policies and cultural change stimulate a beneficial partnership for people and nature.

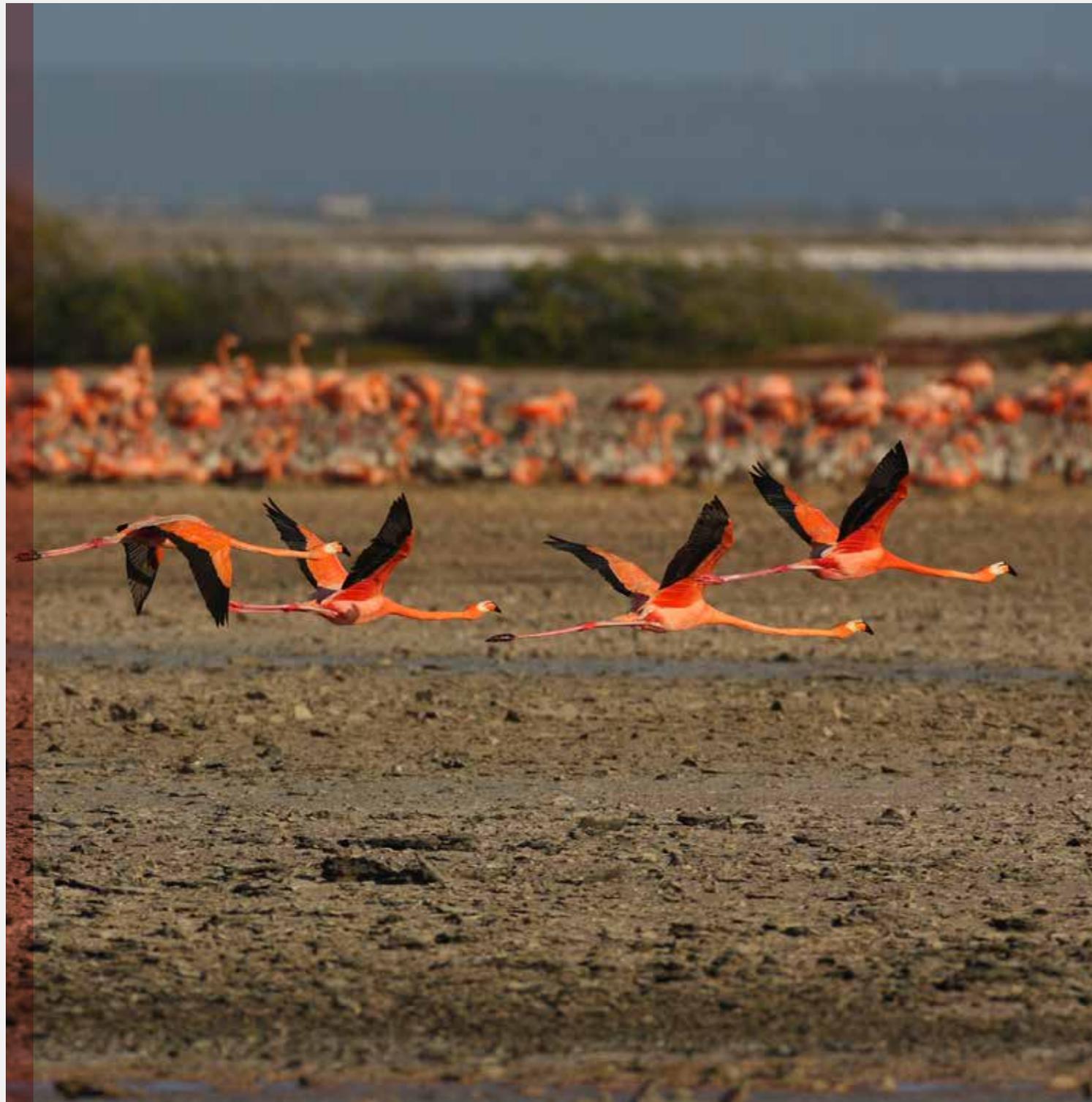
The population on the island has stabilized. Urban expansion is restricted to current designated development contours. The number of cruise ship stop-overs has reduced and the numbers of flight passengers and tourism-related immigration have phased out, halting urban expansion. There is a clear shift to high-end (eco)tourism with family inns, boutique hotels and country retreats.

Most energy is produced by wind-turbines. Households and business buildings are equipped to collect rainwater and solar energy from the rooftops. All energy collected is used over the urban electricity grid, and rural areas store energy on site with batteries. This strengthens the island's energy self-sufficiency, and reduces dependence on fuel imports. Water collected from rooftops and into cisterns is used for watering gardens. It therefore reduces the energy needed to desalinate for production of freshwater. Ponds are also incorporated into the public areas. All these water capturing measures reduce freshwater and land wash-off, protecting the reefs from smothering and excessive nutrient enrichment. Natural watercourses are free from man-made obstructions and the zones around them are revegetated to decrease erosion and increase water absorption into the soil.

Construction of new buildings make optimal use of prevailing wind direction, window blinds and shading by vegetation to create a comfortable indoor climate and limit the need for air-conditioning. For new construction projects the natural vegetation is kept mostly intact; no full clearances take place before construction works begin.

On kunukus, shade trees are planted as fence posts, so that grazers are contained rather than allowed to roam freely. Vegetable and fruit tree production has become more common with local entrepreneurs. Fresh local produce is sold to local restaurants, hotels and supermarkets. Vegetable waste is used as fodder for goats that are kept for meat in fenced ranches. In the valley of Rincon a food forest is developed, which attracts eco-tourism and local activities. Communities and schools also grow food together in local gardens, stimulating the interest in own food production and farming.





# BONAIRE 2050

## A NATURE INCLUSIVE VISION

## A NEW STORY

### THIS IS A STORY ABOUT ONE OF THE DUTCH CARIBBEAN ISLANDS: BONAIRE

A story that is shaped by the people of Bonaire and that may help develop this small beautiful island into an example where well-being and prosperity are balanced with cultural heritage. This vision builds further on the local history of planning, linking ongoing Bonairean and Dutch visions and strategies. It shows Bonaire as an example of embracing nature for our livelihoods.

Experts from Bonaire and The Netherlands have developed this vision for the island in 2050 to inspire you. It is the result of a series of design sessions, interviews and workshops with local experts, decision makers and researchers in the field of nature, culture, recreation, agriculture and governance. The results are views of a future in which economic development and a nature inclusive society join forces to maintain what is precious, and to improve what is already damaged or threatened. We call this a 'nature inclusive vision'.

Some of the challenges that were addressed during the mapping process included managing

(mass) tourism and population growth, preventing high erosion rates due to free-roaming cattle, recharging fresh water in the soil, increasing the use of renewable energy, and adaptation to sea level rise. This would strengthen nature and tackle the one-sided dependency on tourism. Together, we have mapped potential nature-inclusive measures and deliberated where, why and how these could be adopted. These potential measures include for example rooftop water harvesting, reforestation and greening gardens using indigenous species, growing local food, creating cactus fences, installing solar panels and coral restoration.

This vision looks into the policy context and challenges and shows you the characteristics and cultural contexts of the different landscapes of Bonaire. It considers the inclusive concepts that nature can offer to help Bonaire in navigating some of the challenges that were mapped out. This vision is illustrated by three-dimensional landscape visualisations; a Bonaire as you have never seen it before...



**TOGETHER WITH LOCAL EXPERTS A VISION FOR BONAIRE IN 2050 IS PORTRAYED, IN WHICH NATURE AND NATURAL PROCESSES PLAY A KEY ROLE IN ALL DEVELOPMENT ACTIVITIES**

# A POLICY BACKGROUND

## POLICY DEVELOPMENT THROUGH THE YEARS

Economic development in Bonaire gained momentum in the early 1990s. In this period, there was a work surplus, especially in tourism services, and an influx of foreign workers. The lifestyle and culture of Bonairean people were suddenly under severe pressure. These developments demanded a policy framework to guide emerging local problems and external investments, which was launched in 1992 as an integrated socio-economic strategy.

Since 1992, a large variety of policy plans and frameworks have been developed with different accents such as nature, tourism, and culture. For the creation of this nature inclusive vision, these plans were discussed with local stakeholders and taken into consideration for the creation of this nature inclusive vision.



## POLICY PLANS TIMELINE

1992

### INTEGRATED SOCIO-ECONOMIC STRATEGY BONAIRE

- The unique environmental values of Bonaire are the basis for further socio-economic development, other activities such as tourism should be restricted

1998

### DEVELOPMENT PLAN BONAIRE 1998-2002

- High quality tourism with added value to the local economy should be allowed

1999

### NATURE POLICY PLAN BONAIRE 1999-2004

- An overview of the nature diversity of Bonaire and its threats

2010

### MASTER PLAN BONAIRE 2010-2025

- Improving human well-being in terms of solidarity, cultural identity and prosperity

### SPATIAL DEVELOPMENT PLAN BONAIRE

- A legal document to regulate where certain developments could (not) take place

2013

### NATURE POLICY PLAN DUTCH CARIBBEAN 2013-2017

- Managing nature on the Caribbean islands in a sustainable way

### POLICY DOCUMENT ON CULTURE AND CULTURAL HERITAGE

- Balancing the authentic identity of Bonaire with immigration driven population growth

2014

### POLICY VISION FOR AGRICULTURE, HUSBANDRY AND FISHERIES 2014-2029

- Improving the conditions for food production which led to forty implemented projects

2017

### TOURISM PLAN BONAIRE 2017-2027

- Bonaire as 'Blue Destination', tourism and sustainable growth can go hand in hand

2020

### MASTERPLAN BONAIRE 2030

In preparation

### NATURE AND ENVIRONMENT POLICY PLAN 2020-2030\*

- A legal framework for restoration and conservation of natural resources and sustainable land and water use in the Caribbean Netherlands.  
\* presented to island council

# NATURE INCLUSIVE PLANNING

## A NEW WAY OF DOING

Humanity is maintained and depends upon nature. In planning, nature should therefore be factored in up front, instead of compensating later for potential detrimental effects.

- Nature inclusive planning has evolved in various sectors, including agriculture, construction and energy.
- Nature inclusive planning is usually best applied at the landscape scale, while measures are taken at the local scale.
- It is about the improvement of nature in sectors other than conservation.
- Nature inclusive actions complement traditional nature conservation actions (e.g. protected areas), and are not a substitute.
- Nature inclusive measures address societal, cultural and economic challenges while providing benefits to nature at the same time.



WITH NATURE INCLUSIVE PLANNING IT'S ALL ABOUT CREATING POSITIVE OUTCOMES FOR BOTH NATURE AND PEOPLE



## EXAMPLES OF NATURE INCLUSIVE MEASURES

### PLANTING CACTUS FENCES

Natural protection from roaming livestock, appealing landscape, attracts birds and small reptiles.



### ROOFTOP WATER HARVESTING

Use fresh water for drinking or watering plants, less expensive than desalination.



### GREENING GARDENS

Trees create shade and increase living area for butterflies and birds.



### REVEGETATION

Decreases land wash-off, keeps more water in the soil while providing shade.





# BONAIRE'S CHALLENGES

As a small tropical island, Bonaire is rich in biodiversity and hosts a wide variety of globally threatened natural areas. These areas are important for coastal protection and tourism, as well as for erosion control and resilience to climate change.

At the same time, there are many different pressures that combine to impact both nature and other forms of land use in this small area. These include a rapidly growing population and tourism industry which lead to the expansion of the built environment. Natural pressures include climate change, salt water intrusion and erosion, for example. The following section describes the challenges that Bonaire is facing in more detail.

# URBAN AND ELITE ESTATE EXPANSION

## BONAIRE'S CHALLENGES

Around 500 AD, Caiquetio Indians (Arawak descendants) reached the island from Venezuela. A thousand years later, the Spaniards invaded Bonaire. They brought goats and donkeys, and started Rincon as their first settlement on the island. Rincon was strategically chosen as it is nestled within a valley with natural water sources, fertile lands, and is hidden from potential invaders. It also has easy access to a lookout for spotting impending danger from pirates. Over the following decades several other settlements developed such as Antriol.

Early in the 17<sup>th</sup> century, the Dutch invaded Bonaire in search of salt to preserve food. They started building fortifications on what is now known as the centre of Kralendijk. More settlements developed (e.g. Nikiboko, Noord Saliña and Tera Cora) and fisherman built their homes along the coast. Until a century ago, the inhabitants of Bonaire were mostly self-sufficient in their demand for food. From their homes in the settlements, they tended small plots of land, known as kunukus, to grow crops and to keep goats.

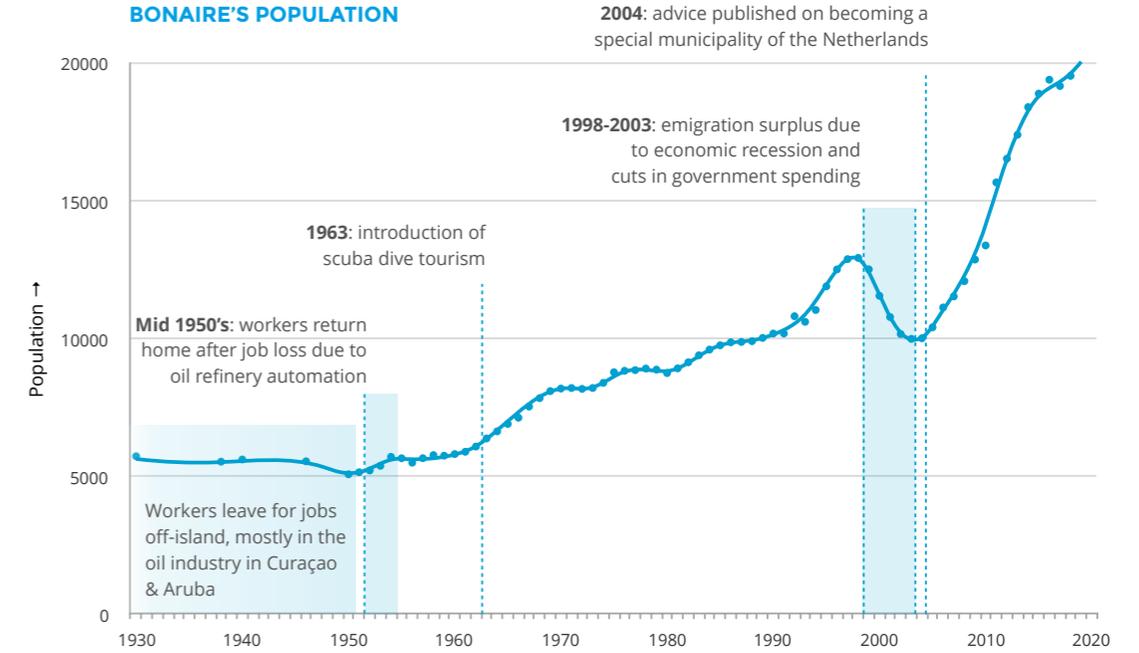
In the 1960s the oil industry emerged in Venezuela, Aruba and Curaçao. The tourism

and the banking sector started to grow. As a result, people left their kunukus to take on less physically demanding jobs in the urban area and off-island. This way they were able to earn enough money to buy imported, non-local food from the supermarket. The kunukus became less important and many were abandoned or left neglected. As most kunukus were owned by large families, the plots of land got parceled up for the generations to follow. More recently, kunuku owners have started to sell their unused and relatively small kunukus to foreigners.

In 1961 Bonaire had a population of 5,800, which tripled to 15,000 by 2010. After Bonaire became a special Dutch municipality in 2010, the population increased to 20,000 in ten years' time, mainly due to immigration. Population growth mostly takes place in urban areas. Over these decades the original settlements, except more remote Rincon, conglomerated into present Kralendijk, that has continued expanding since then. Recently, plans for housing development have been proposed on the distant unspoiled east coast of Bonaire ('Bolivia'), although these have not yet been approved by government and remain highly contentious among the local residents.



## BONAIRE'S POPULATION



## EXPANSION OF KRALENDIJK AREA

displayed in red (1911 - current)



# A CHANGING CLIMATE

## BONAIRE'S CHALLENGES

The Caribbean region has a tropical climate, with wet and dry seasons. Bonaire, however, is located in the rain shadow of the Andes and therefore has a dry climate.

It is expected that the average temperature will rise 1.4 degrees Celsius. This is a development that can already be observed from the monthly temperature average of the past forty years. Rainfall is expected to decrease by 5%, and the sea level to rise by 0.6 metres.

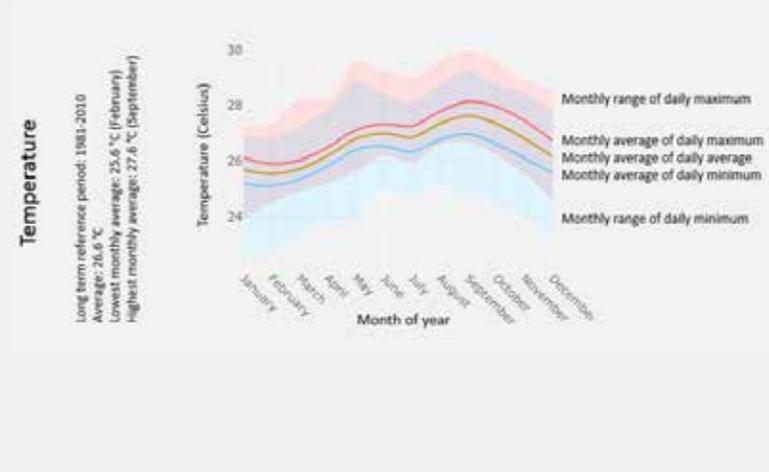
Extreme events such as sea storms and droughts are expected to occur more frequently.

Climate change will likely impact both the natural and socio-economic situation on Bonaire. The lower lying and coastal areas that host many of the resorts, residential areas, salt ponds, mangroves and (turtle nesting) beaches are likely to become subject to more frequent damage from sea storms. The sea level rise will

cause permanent flooding. In addition, sea water temperature rise is already weakening corals' resistance against diseases making these reefs less attractive for dive tourism. The expected decrease in rainfall will further limit growth of natural vegetation. As the roots of this vegetation will then no longer hold the soil together, this will increase the risk of soil erosion. Soil is then flushed into the sea, smothering the coral and making the situation even worse.



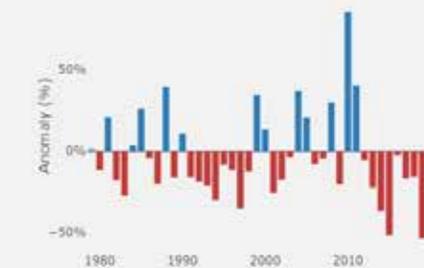
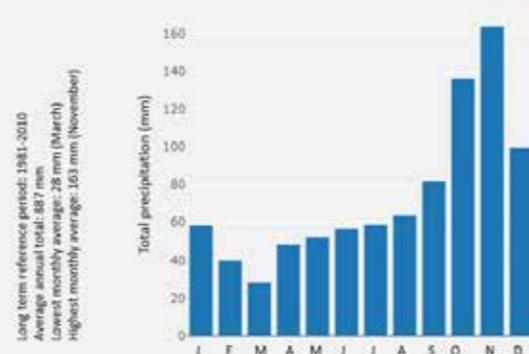
## MONTHLY AVERAGE (1979 - 2019)



## ANNUAL ANOMALY (1979 - 2019)



## Precipitation



The graph shows how much more (blue) or less (red) precipitation fell each year as a percentage relative to the long term reference period of 1981-2010

# DIVERSIFYING THE ECONOMY

## BONAIRE'S CHALLENGES

Bonaire's economy relies largely on tourism, with about 500,000 cruise and stay-over tourists a year among a population of 20,000. The direct tourism expenditure is estimated at around 40% of the Gross Domestic Product of 428 million US dollars in 2017.

Both direct and indirect tourist expenditure provide jobs for many locals in accommodation and food serving (16%), recreation and cultural activities (9%), construction (7%), wholesale and retail

(14%). This dependency on tourism makes the island's economy vulnerable to fluctuations in the market, global health issues and extreme weather events.

The COVID-19 crisis is an example where all tourism related activities were shut down. The island would benefit from a more diversified economy in which a variety of sectors contribute more evenly to the economy. Diversification could take place through stimulating the further development of financial and IT

services (requiring stable, high-speed internet facilities) or bio-pharmaceutical industries (algae and aloe).

Other forms of diversification could be increased local vegetable and fruit production or goat meat and brine shrimp (live food for fish) production. Such bio-pharmaceutics and agricultural products could enhance export both within the Caribbean region and as a trade-centre and transit port, e.g. between Europe and Latin America.

# USING RENEWABLE ENERGY

## BONAIRE'S CHALLENGES

Bonaire depends heavily on imported fossil fuels for the provision of energy. Currently, 69% of the energy supply originates from burning fossil fuels (equals 300 heavy oil barrels per day). The remaining energy is generated from wind turbines (32%) and solar panels (1%). As a consequence, electricity costs are high and prices are vulnerable to fluctuations depending on oil supply.

While environmental conditions on Bonaire offer opportunities for the generation of sustainable wind and solar energy, they require improvements to the electricity network. The global aspiration of reducing greenhouse gas emissions, as agreed upon by all members of the United Nations in the 2015 Paris Agreement, presents a potential opportunity for Bonaire to fund investment in renewables. The Netherlands has set its goal for a greenhouse gas emission reduction of 49% by 2030 compared to 1990. By 2050, the goal is to have a fully sustainable energy supply.



# MANAGING TOURISM

## BONAIRE'S CHALLENGES

High numbers of tourists are not a new phenomenon on Bonaire. The numbers of annual tourists exceeded the island population size as early as 1976. Since then, the numbers of tourists have grown exponentially. Today, the annual tourist numbers exceed the local population size by a factor of 25. For comparison, in The Netherlands this factor is 1 for 2017 (a population of 17.2 million and a total of 17.6 million foreign tourists).

Two thirds of all tourists visiting the island annually are cruise tourists. Cruise tourism in Bonaire grew steadily in the 1990s and early 2000s, and started growing exponentially in the mid-2000s. In 2006, cruise ship tourism overtook the annual number of stay-over tourists. Cruise tourist visits are concentrated in a few months a year, between October and April. Typically, these tourists stay on the island for a few hours during which they wander through the town of Kralendijk, visit beaches or drive around the island in tour buses, mini-vans, taxis, golf-carts, quad-bikes and motor cycles. Road congestion occurs during disembarking and embarking. Off-road use of quads and motor cycles have additional social and environmental impacts, such as traffic dangers, the uncontrolled creation of new roads as well as disturbance of residents and nature. Cruise tourists make

little use of local hospitality services as cruise lines offer all-inclusive arrangements. Stay-over tourists mainly visit the island for diving. The number of these tourists has increased substantially since 2010 when Bonaire became a special municipality of the Netherlands.

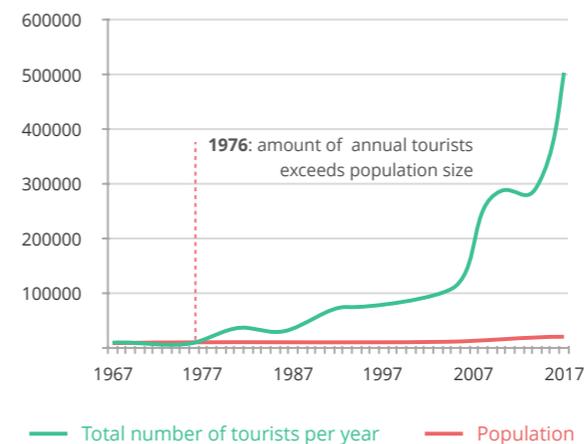
Increased tourism puts pressure on built infrastructure, especially on the west coast, north and south of Kralendijk, and popular locations, such as Lac Bay. This protected nature area is increasingly being used for sunbathing and surfing. Discussions to relieve the pressure on these hotspots have identified several alternatives for expanding the range of tourist activities. Examples are hiking, mountain biking and driving routes through the rural areas, mangrove kayaking, caving, museums with local culture, and local cuisine. The number of tourists could also be limited by setting a (daily) maximum. This number can be differentiated by location, as practiced in e.g. several National Parks elsewhere in the world. These potential alternatives offer a broader 'Blue and Green Destination'. However, they may also increase the pressures on other relatively undisturbed communities and sensitive natural areas on the island.



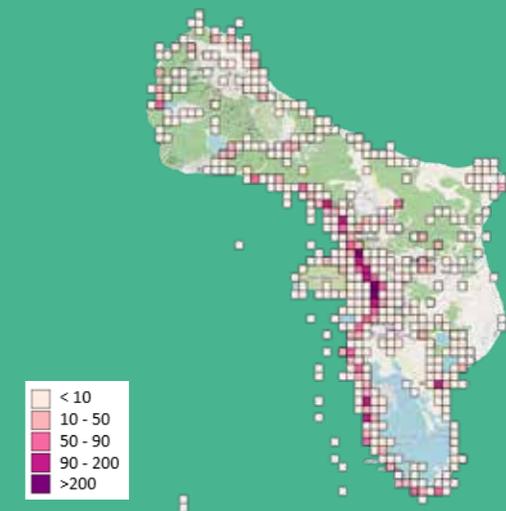
## TOURISM DEVELOPMENT ON BONAIRE



## NUMBER OF TOURISTS AND POPULATION



## NUMBER OF PHOTOS TAKEN AT TOURISTIC SITES



# RECHARGING FRESH WATER IN THE SOIL

## BONAIRE'S CHALLENGES

Bonaire is positioned in the tropical zone, but has a dry climate as prevailing winds bring little precipitation. Due to climate change Bonaire is expected to receive even less rain. A lot of rain water evaporates before it can sink into the soil. If it does infiltrate the soil, it easily seeps away into underground cracks and fissures where it flows over the sloping subsurface to the sea. This limits the supply of fresh water for agriculture and drinking water. Dams, that previously held fresh water for agriculture, were abandoned during the emergence of the off-island oil industry that attracted workers from Bonaire. Until the 1960s, the drinking water supply of the island relied on a few fresh wells. However, as demand increased with increasing population and tourists, desalination plants were constructed to produce water via reverse osmosis from sea water. Water wells are now primarily used for construction, watering of private gardens and agriculture, as water from desalination plants is more costly.

There has been extensive drilling of private wells for these uses, which has led to further depletion of groundwater. This extraction of groundwater has led to salt intrusion, making the water unusable for drinking and for irrigation in traditional agriculture and horticulture. Nowadays, extensive salt water intrusion occurs in most government-managed water wells. This extensive groundwater extraction and the influx of salt, worsened by sea level rise, undoubtedly impacts the natural vegetation and agricultural yields.



# MAINTAINING, ENHANCING AND RESTORING NATURE

## BONAIRE'S CHALLENGES

Bonaire hosts a wealth of biological diversity. Many species are endemic to the island, found nowhere else in the world. Its coral reef diversity and offshore diving attract many tourists. Apart from the marine diversity, the island itself offers diverse habitats that serve as a haven for dozens of animal and plant species. Many of these are globally threatened. For example, the island is a haven to stable, or even increasing, populations of globally threatened flamingos, which have become a biodiversity, tourist and cultural heritage icon of the island. The land, coast and fringing waters are rich in dry tropical forests and scrublands, caves, beaches, mangroves, seagrass beds and coral reefs. There is an international responsibility for the maintenance and strengthening of Bonaire's nature, both on land and at sea, as ratified in several national and international treaties.

Nature on Bonaire is vulnerable due to its small area and inherent-

ly small populations of species, making them particularly vulnerable to habitat loss, fragmentation and degradation. Like all islands in the Caribbean region, Bonaire suffers from invasive alien species and climate change. For example, invasive seagrass is substantially lowering the species density of Bonaire's indigenous turtle grass. Impacts of high (non-indigenous) free roaming livestock numbers, present a major impact on the nature of Bonaire, as they consume island vegetation faster than it can regenerate. This results in low water retention and high erosion rates. Runoff of eroded soil to the sea increases the pressure on marine habitats and in particular, smothers the very coral reefs that currently attract the majority of tourists. Restoration activities to lower free-roaming livestock numbers (particularly in sensitive areas) and restore vegetation cover, can greatly limit the impact of erosion on natural areas on land and in the ocean.

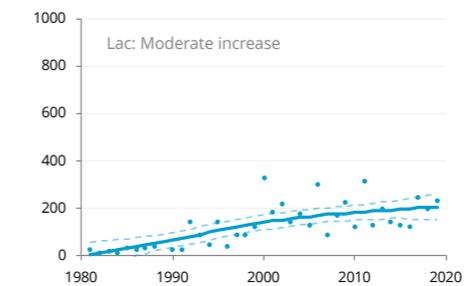
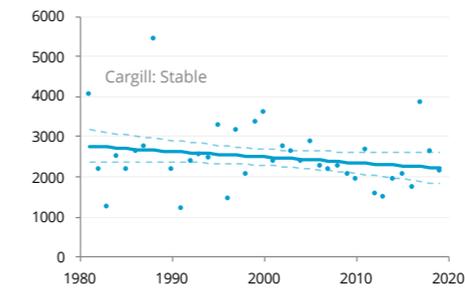
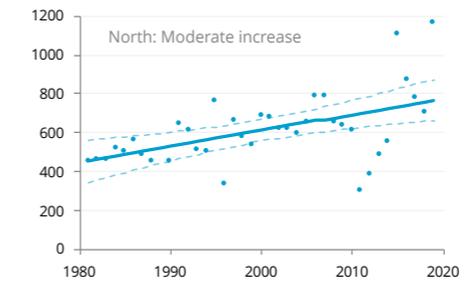


Figure 8 – flamingo abundance

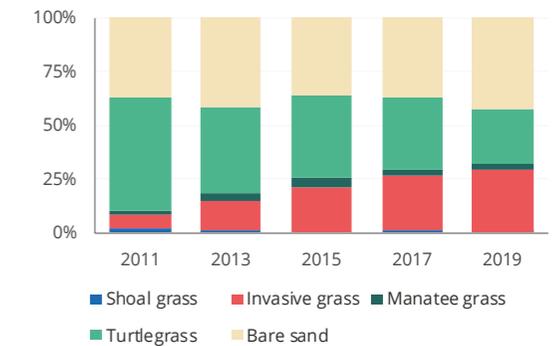
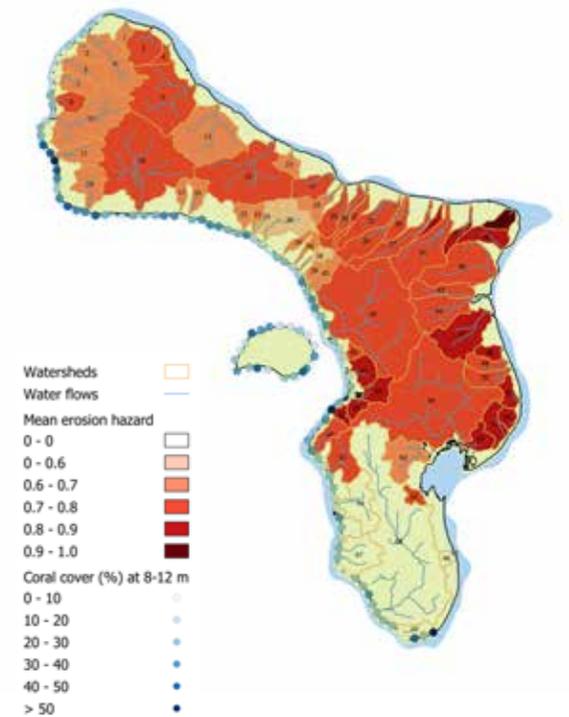


Figure 9 – seagrass species density in central Lac lagoon



## LOCAL PRODUCE AND HEALTHY DIETS

### BONAIRE'S CHALLENGES

Traditionally, food was produced locally on kunukus. Diet mainly comprised of goat, chicken, fish and starchy produce (sorghum), with limited fruits and fresh leafy vegetables. Nowadays, Bonaire is 99% dependent on imported food. These imports result in high vulnerability to price fluctuations on the global market and import-restricting policies. Local experts estimate that 40% of the vegetable and fruit needs could be produced on island. Currently, home-grown food attracts attention through several local initiatives, for instance the cultivation and selling of indigenous fruit trees by garden centres and horticultural

undertakings. Vegetable gardening also helps to some extent to cut down on household food expenditure. However, these types of initiatives and entrepreneurship need to be greatly upscaled to lower the dependency on imported food. This is especially important for the large low income group that suffer from high supermarket prices. Groceries are 40% more expensive than in the European Netherlands due to the small market, high shipping costs, high refrigerating costs and low supermarket competition.

An upscaling of local production also has the potential to improve the overall

health and nutrition of islanders. Currently, stews and deep frying are a popular way to prepare food. Six in ten residents of Bonaire are overweight, of whom half are obese. Women and men are equally likely to be overweight, but obesity is relatively more common among women. Local production of water melon, tomatoes, spinach, lettuce, pumpkin and okra is likely to provide better and more affordable access to more nutritious food. To change the consumption patterns, children are already being educated at primary schools. This provides potential for stimulating the demand of local produce.

## FLOURISHING CULTURAL HERITAGE

### BONAIRE'S CHALLENGES

Over the centuries, Indian, African, Portuguese, Spanish, English and Dutch traders, slave and colonist cultures merged to produce a richness in Bonairean tales, songs, poetic language, architecture, local dishes, music and folkloric dancing.

From the 17<sup>th</sup> to 19<sup>th</sup> centuries, huge tracts of land were turned into private plantations to cultivate medicinal aloe and raise goats for meat and hides, harvesting salt to preserve food, and Brazil wood for red dye. For generations Bonai-reans lived from the sea (off fish, turtles, shellfish, salt and burnt lime production), or from their small plots of farmland (kunukus) on which they grew the staple grain sorghum (known as maishi chikitu) and tended their goats.

Local crioyo (Creole) dishes mainly include stews from fish, chicken and goat, seasoned with native herbs and a variety of fresh vegetables and fruits (pumpkin, plantain, mango and papaya). A popular side-dish is funchi (traditionally cooked with Sorghum flour). These local dishes are barely found on tourist menus.

Arousing interest in the cultural heritage, and the natural and cultural landscapes of Bonaire could strengthen the feeling of connection with the land and the preservation of the values of the area. Strengthening differentiation in the tourism offerings through musical and dance presentations and traditional food specialties by locals, is likely to improve the island's prosperity and well-being of its inhabitants.

# INTERWEAVING NATURE IN BONAIRE'S LANDSCAPES — A VISION TOWARDS THE FUTURE

In a nature inclusive society, societal challenges are addressed while providing benefits to nature. Thus nature inclusive planning measures implemented to combat challenges for any sector, will also strengthen nature. The types of measures that are applied depend on the local and spatial context:

the biophysical, cultural and aesthetic characteristics. This is what makes Bonaire so interesting; the landscape is very diverse with dry cacti forests, traditional kunukus, coralline coasts, biodiverse reefs, extensive salt flats, vibrant villages and tasty traditional cuisine.

Island experts located nature inclusive measures on a map. These measures formed coherent clusters which, in combination with soil, topography and vegetation maps and historical use, resulted in the landscape map as shown on the next page.



# KRALENDIJK URBAN FABRIC

Kralendijk is situated on the inside corner of Bonaire, sheltered from the wind, with calm beaches and easy access to the reef.

## 2050 VISION

Kralendijk is the vibrant tourist centre of Bonaire with a variety of locally owned and staffed restaurants serving traditional food. Stay-over tourist stay at a balanced variety of family inns, hotels and small resorts. Urban growth takes place within the borders of this zone. The natural water courses ('rooien') and hypersaline lagoons ('saliñas') are buffered by naturally vegetated building-free zones. These buffers prevent flooding during heavy rains and host wildlife. Sediment traps prevent soil and dirt from running off into the sea and onto the corals. Excessive storm water is collected through a system of drains and (partially underground) canals into a natural reservoir. Semi-permeable pavement is used on parking lots and squares to allow rainwater to seep into the soil, recharging the ground - water, and preventing soil erosion by wind and water.

Rainwater is optimally harvested from roads and solar panel covered roofs and stored in cisterns. It is used to water private and public gardens and to recharge groundwater. Road verges and (hotel)

gardens are rich in indigenous shrubs and trees (including the iconic Sabal palm). They form a network that connects public parks and temporary pools for collecting rainwater. The lush vegetation attracts urban wildlife and the parks are a shaded resting and meeting place for both Bonaireans and tourists. As there is no roaming livestock in town, the natural infrastructure can develop undisturbed and there are no (nightly) road accidents from crossing livestock.

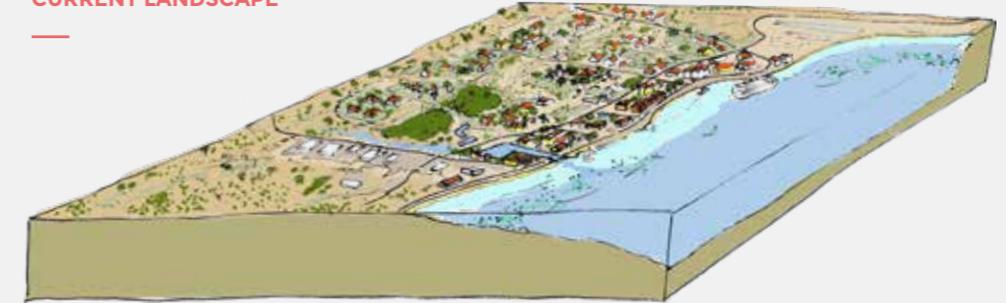
Construction of buildings make optimal use of prevailing wind direction, window blinds and shading by vegetation to create a comfortable indoor climate and limit the need for air-conditioning. The use of wells for providing gardening water is in balance with ground water levels. Private well drilling is regulated and enforced.

The entire shoreline of Kralendijk is publicly and freely accessible to everyone, wide enough to protect against sea-level rise and surges, and includes restricted areas for nesting of sea-turtles.

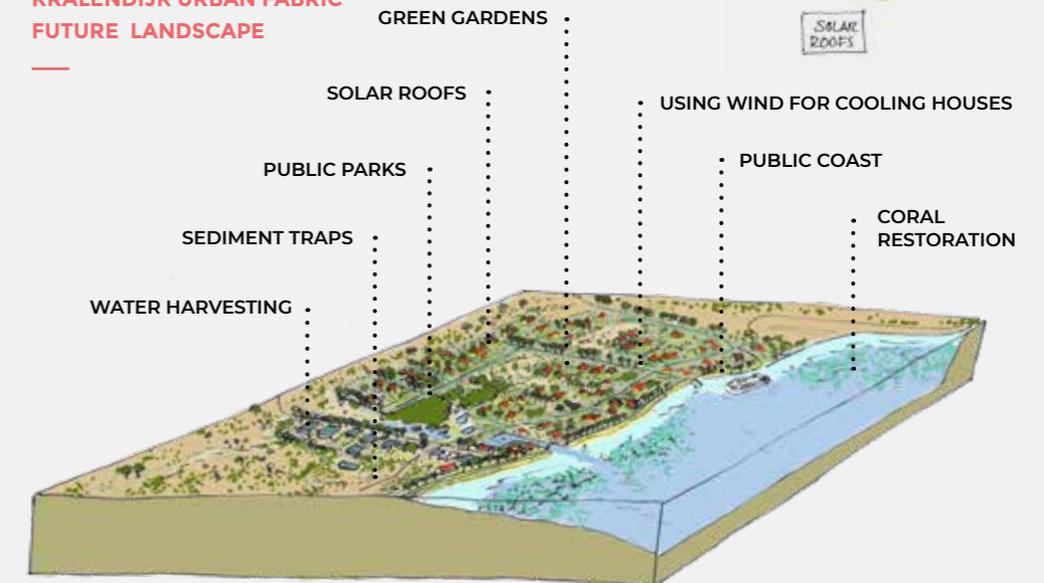
Just off the coast, corals that suffered from erosion and nutrient overload are now in healthy conditions and capable of growing with fluctuating sea levels.



## KRALENDIJK URBAN FABRIC CURRENT LANDSCAPE



## KRALENDIJK URBAN FABRIC FUTURE LANDSCAPE



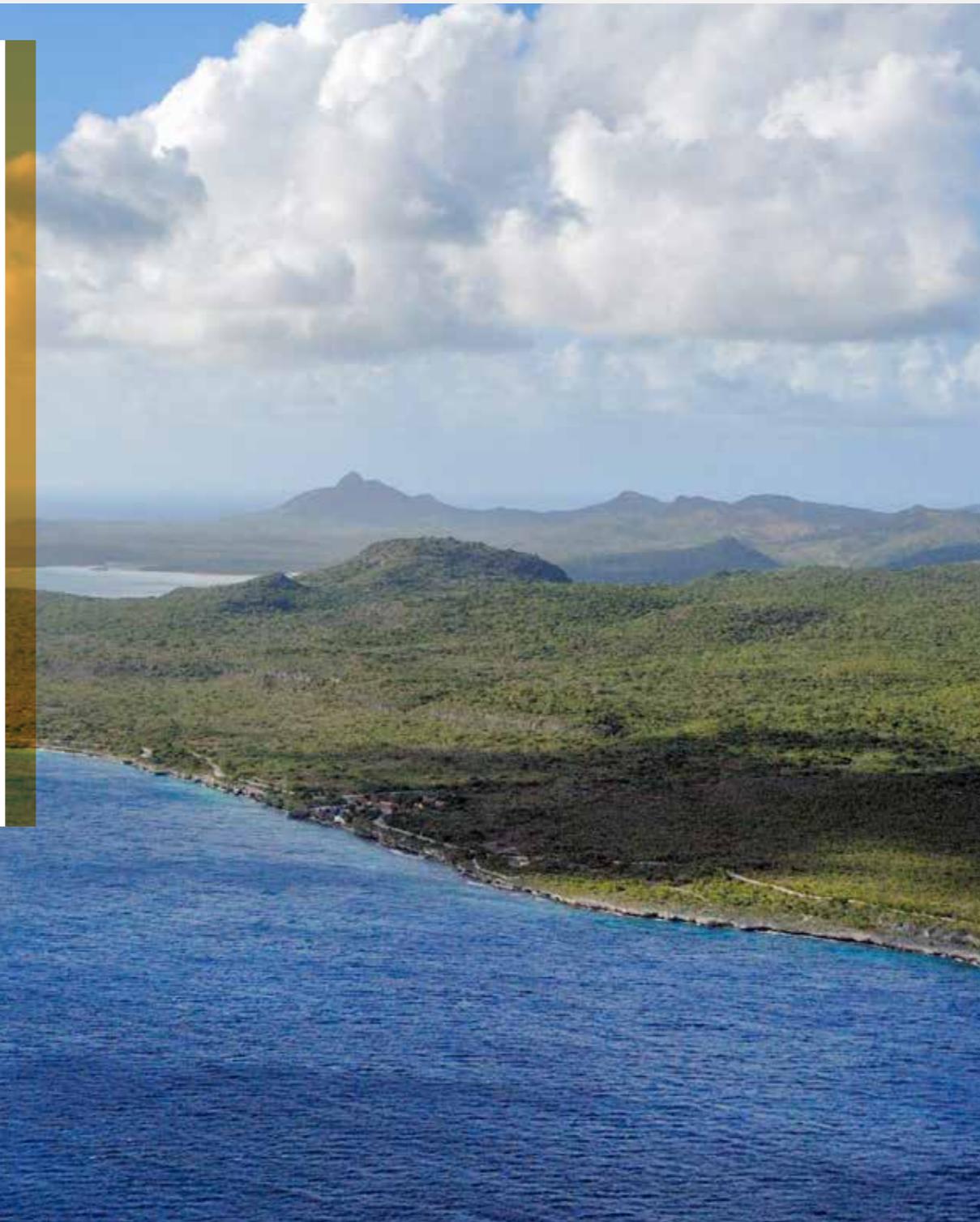
# CALM CLIFF COAST

Along the scenic road that meanders along the calm coast from Kralendijk to the northwest, a narrow stretch of land is confined between a naturally terraced cliff that drops down into the sea.

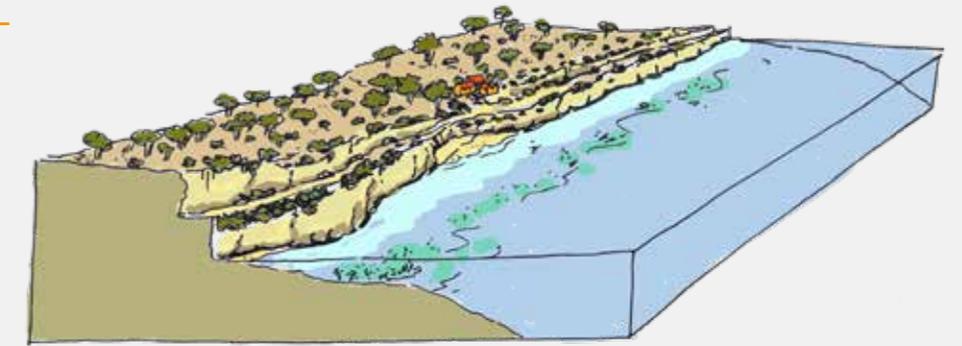
## 2050 VISION

The beach is covered with a thick layer of bleached remnants of stone corals. The cliffs are vegetated with characteristic salt tolerant plants, like the Seagrape, the Turk's cap cactus and, further from the shore, ground dwelling bromeliads and the Prosopis with special yellow pompom shaped flowers, that contrast with the darkness of the rising cliffs and its caves.

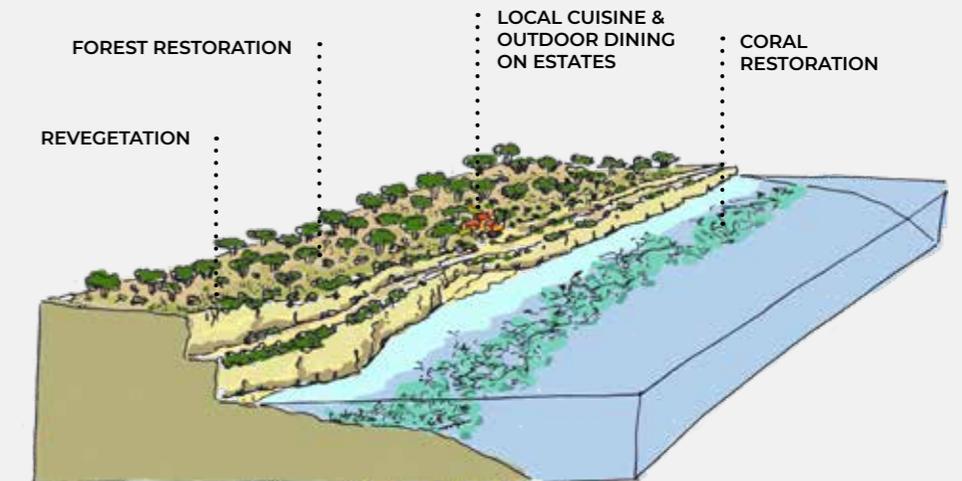
The renovated monumental manor of the former plantation of Karpata accommodates roofed outdoor dining facilities with local cuisine and a beautiful view across the sea towards Klein Bonaire. The dry forest surrounding the manor has been restored to its former glory.



## CALM CLIFF COAST CURRENT LANDSCAPE



## CALM CLIFF COAST FUTURE LANDSCAPE



# CALCAREOUS ANCIENT FOREST PLATEAU

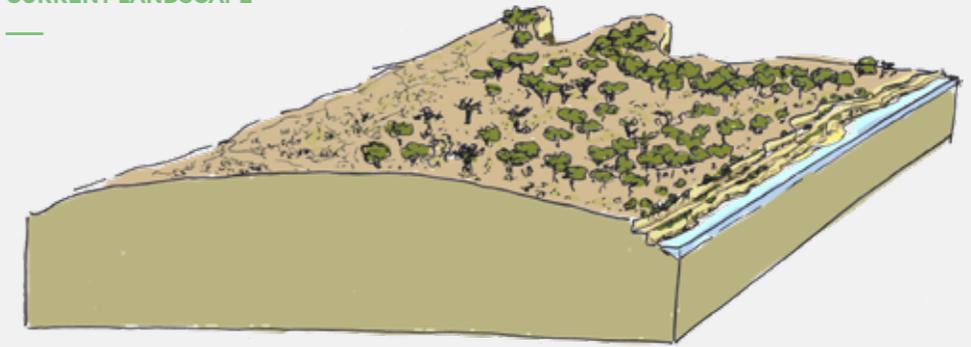
The middle Bonaire limestone terraces were formed by coral reef growth during periods of varying sea levels as the land was lifted up and the sea rose and fell during the ice ages. The limestone cliffs rise up from the shore with nearly vertical steps between the terraces. Rainwater has dissolved the limestone into a sharp-edged karst landscape with sinkholes, caves and limestone ridges. This hampers human entry, thus natural vegetation has mostly been undisturbed and large native trees have been able to develop. These calcareous species are evergreen. They keep their leaves even during the driest months in contrast to the trees on volcanic soils that drop their leaves in the dry season.

## 2050 VISION

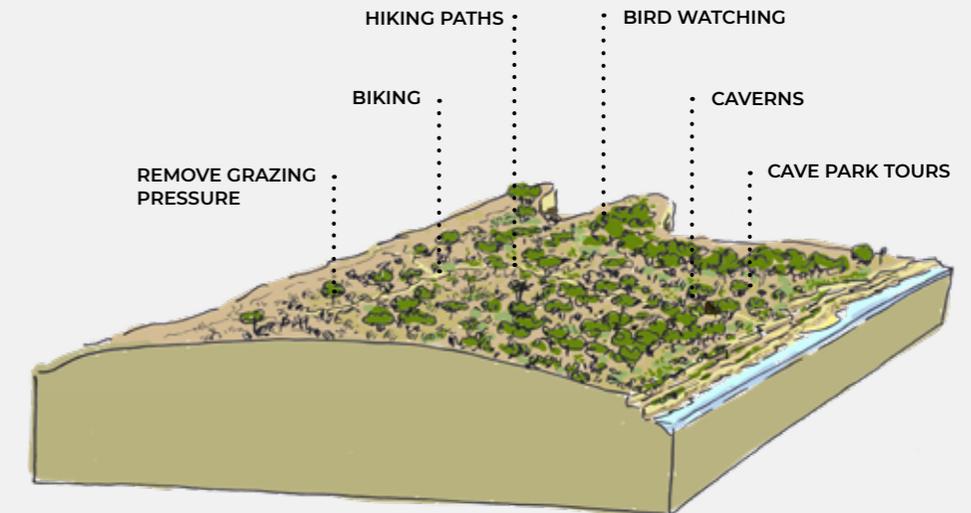
After years of extreme grazing pressure that led to extreme degradation of nature, targeted revegetation actions have helped to recover the forest. High up on the leeward side, pockets of rare orchids grow on these large native trees. The forests create relatively cool micro-climates and store carbon. Ground-dwelling orchids have developed after removal of roaming livestock as part of the establishment of this terrestrial calcareous forest park. The numerous caverns are home to different species of bats. Fruit trees are common and provide food for colonies of endemic parrots.

The park holds a network of low-impact walking trails that are used by tourists and locals for recreation purposes and to experience the ancient, tropical dry forests. Local islanders offer guided tours for exploration of the limestone plateaus. The highest peak, Seru Largu, forms an attractive viewpoint that can be reached by climbing, jogging, or cycling the hill. Others opt to enjoy its views on an evening walk.

CALCAREOUS ANCIENT FOREST PLATEAU  
CURRENT LANDSCAPE



CALCAREOUS ANCIENT FOREST PLATEAU  
FUTURE LANDSCAPE



# NORTH-WESTERN HILLS

During colonial times, the volcanic hills in the north-western part of the island contained two of the largest and most productive plantations. The plantations supplied salt, charcoal, aloe extract, divi-divi pods for use in leather tanning, and goats for export to Curaçao and Europe. In a good year, 3,000 or more goats would be shipped to Curaçao from the bay known as Slagbaai. In 1969, these former plantations were turned into the Dutch Caribbean's first protected nature area which also acknowledges the rich cultural and historical heritage.

## 2050 VISION

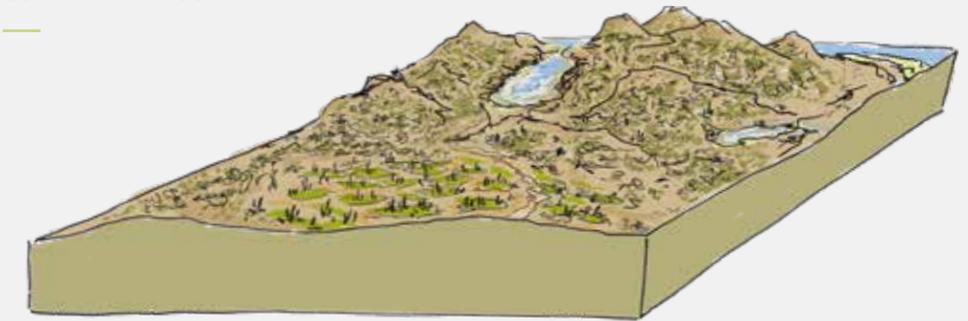
In 2050, the park will cover the entire north-western hills and will be mainly vegetated with low thorny scrub and cacti, which is typical for dry environments. Moreover the park is home to a variety of distinctive habitats such as sand dunes, hypersaline lagoons (saliñas) and relatively moist patches with Tillandsias (epiphytic Bromeliads) along the south-west coast. The herbal understory has recovered after roaming livestock removal, and the shrub layer and tree layer have become more diverse. After years of extreme grazing pressure, targeted revegetation actions have helped recover the dry forest. These actions have improved soil retention, water infiltration, nutrient cycling and carbon storage.

The area provides a safe haven for many of the island's native plants and animals, including parrots, parakeets and iguanas. It is a sanctuary to seabirds, shorebirds and terrestrial birds, many of which use the park as a stopover on their migratory route. Saliñas, such as Gotomeer, are nesting and foraging grounds for many species of waterbirds, among them the endangered Caribbean Flamingo. These saliñas have been dredged to restore the water storage capacity, preventing sediments from smothering the reef.

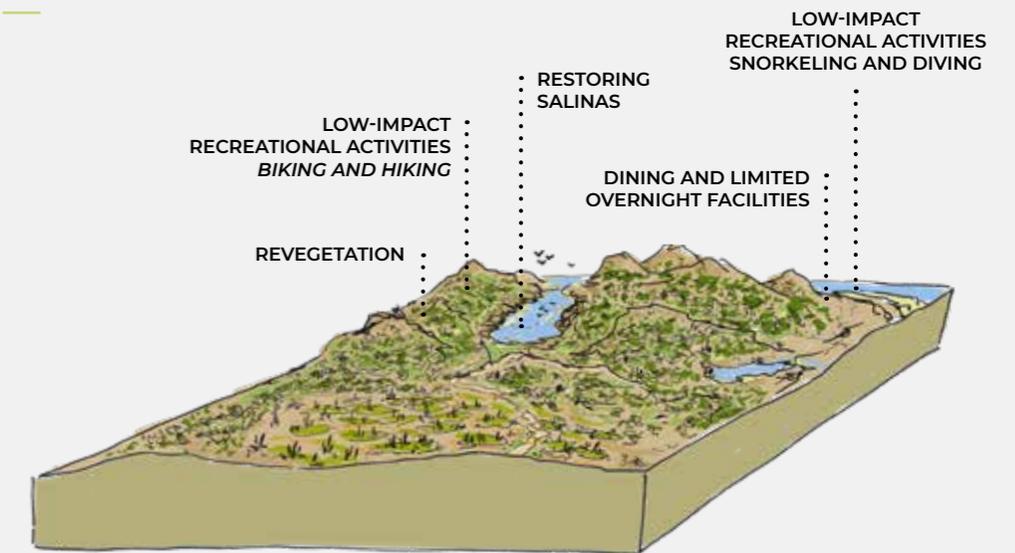
The area offers a wide range of low-impact recreational activities. These include hiking, birdwatching, mountain biking, snorkelling and diving. Some of Bonaire's most beautiful reefs can be accessed directly from the park's coastline and are now restored. The former plantation estate offers dining and low-impact overnight facilities for visitors.



NORTH-WESTERN HILLS  
CURRENT LANDSCAPE



NORTH-WESTERN HILLS  
FUTURE LANDSCAPE



# TRADITIONAL VALLEY OF RINCON

The substrate of Rincon is formed by old volcanic rock that surfaced from the ocean over 60 million years ago. During the rainy season, the volcanic hills erode and fertile material is deposited in the valley. This, together with the occurrence of natural wells, makes the area suitable for small scale agriculture and horticulture.

## 2050 VISION

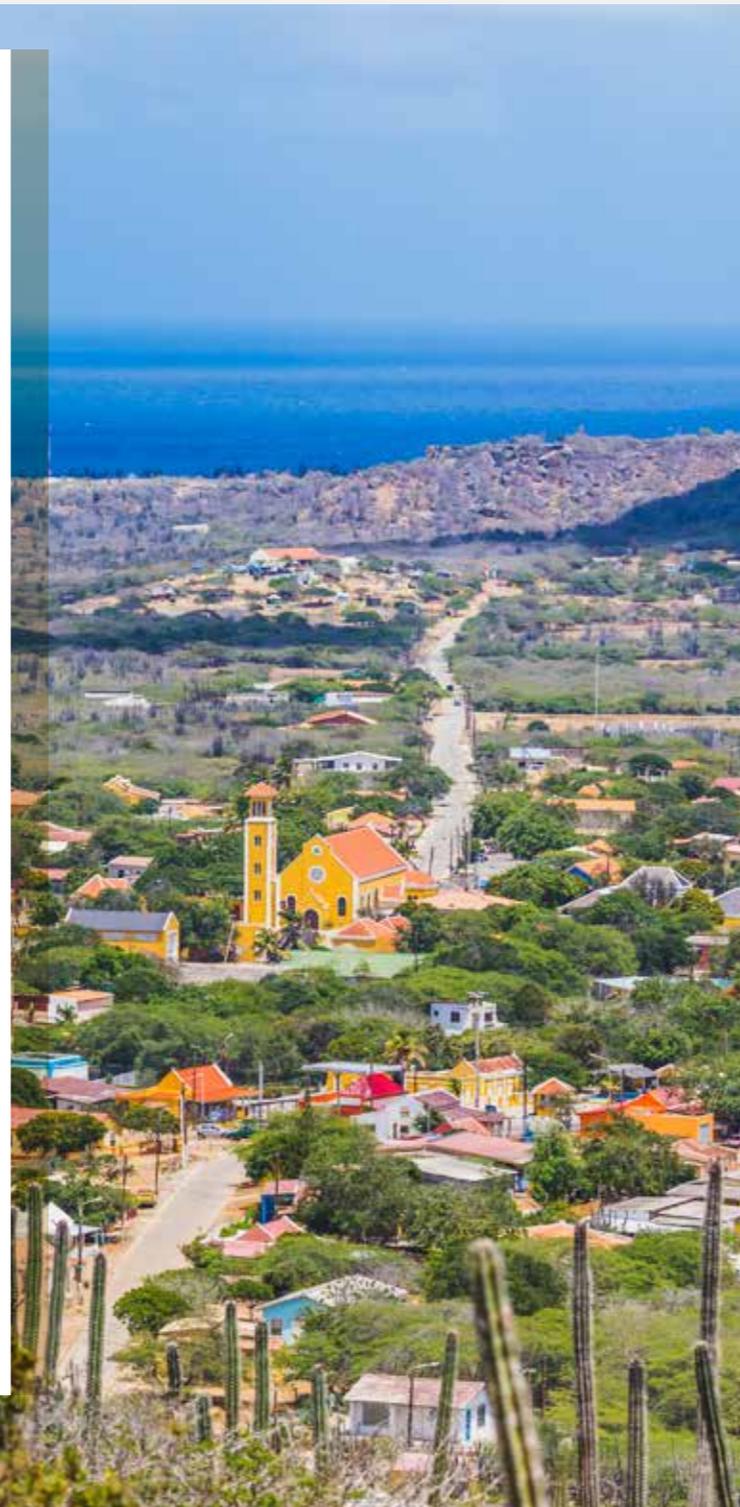
By 2050, extensive agriculture and livestock raising takes place in the valley surrounding Rincon. Several natural watercourses ('rooien') drain rainwater from the surrounding hills during the rainy season. Some of these end in a reservoir ('tanki'), partially surrounded by an artificial barrier ('dam'). The water in these reservoirs is used for agriculture. Fields and gardens are traditionally hedged with cactus fences and livestock is kept in corrals, also fenced with cacti.

Rincon lies in the centre of this valley and is the cradle of the rich Bonairean culture. Rincon's typical townscape together with its surrounding small agricultural fields is preserved in the form of a landscape park and protected from urban sprawl. The population of just below 3,000 people in 2017 will remain stable in 2050. Agricultural fields produce food for personal use and ingredients, such as pumpkin, plantain and goat meat

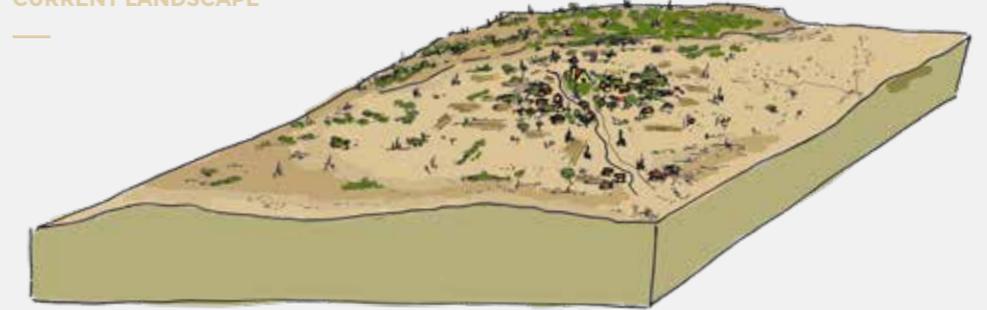
for highly-promoted local menus in (specialised) restaurants that target the tourist market. Additionally, gardens are used to improve nutritional value of the diet of the islanders through growing fresh leafy vegetables and fruits. Regenerative agricultural practices including no-till farming, agro-forestry and regenerative grazing are common in Rincon leading to healthy soils and productive farms.

A great variety of (indigenous) trees is abundant in the village and the surrounding agricultural fields. The trees provide shade, prevent erosion, enable water recharge and are a rich habitat for the abundant wildlife such as iguanas and parrots. Rainwater for gardens and crops is harvested from rooftops and well-maintained canals, dams and ponds. The number of wells and their use is regulated and enforced. Natural watercourses are free from buildings. They are deepened and widened to restore the water storage capacity.

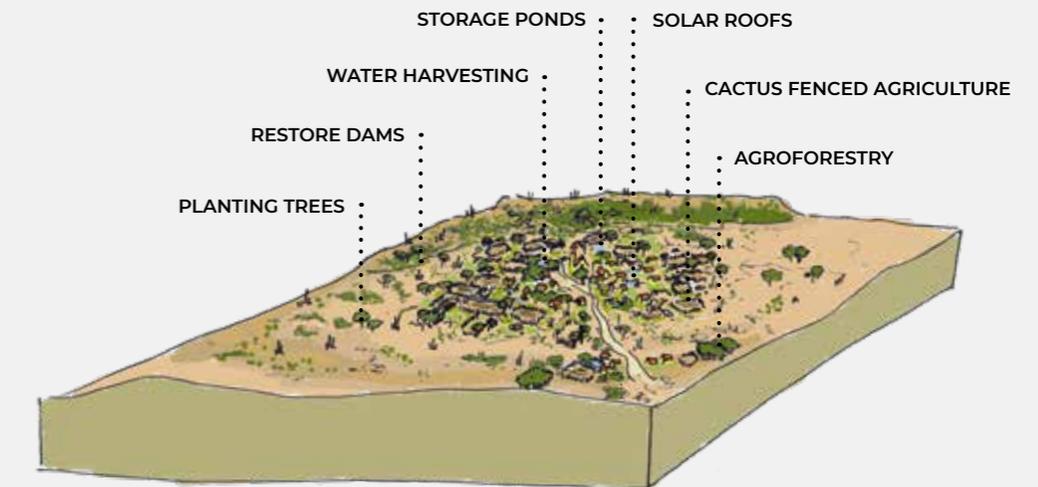
Rincon is an attractive cultural and landscape park for tourists on a day trip. To maintain the typical character, the daily number of tourists to the Rincon valley is restricted. Rincon hosts a small number of family inns and country retreats for stay-over tourists.



TRADITIONAL VALLEY OF RINCON  
CURRENT LANDSCAPE



TRADITIONAL VALLEY OF RINCON  
FUTURE LANDSCAPE



# KUNUKU

Previous to European discovery of Bonaire, the Caiquetio Indians from South America built small dams ('Conuco') to retain the rainwater. They used these dams as well as the rainwater to grow mainly sweet potato, as they did in their country of origin. This was the beginning of what we now know as the kunuku landscape. The kunuku provided meat, aloë, dividivi pods for leather tanning, charcoal, goat dung as fertiliser, goat skin, sorghum, maize, beans, vegetables and fruits.

## 2050 VISION

The small-scale agricultural mosaic of the kunuku area remains peacefully quiet, in contrast to vibrant Kralendijk.

A number of manors of estates on former plantations have been renovated and accommodate popular roofed outdoor dining facilities that are well known for their local cuisine.

Several aloe farms are located in the kunuku area. The well adapted aloe grows in the rainy season and is harvested at the end of the wet season when the leaves are full of juice. These farms can be visited and have a small

shop with nourishing, high-end, home-made body creams.

Through investments, shaded and drip irrigated horticulture produces a vast amount of vegetables and fruits that are well adapted to the local climate and are locally sold. In addition to shaded greenhouses, solitary trees, tree rows and small fruit tree orchards provide protection against the sun. To limit maintenance of the drip-irrigation system, only perennial crops, like okra and papaya, and orchard fruits like tamarind, lime and soursop are grown. Horticultural activities require fresh water and are therefore located close to the island's sewage treatment plant and several communal desalination units. Each desalination unit produces enough water for about 50 horticulturists per day and runs completely on solar and wind energy generators. Farmers own a limited number of goats for their consumption, which are fed by residues from their farm.

Larger scale goat farming takes place in a dedicated zone. Typically fields are either fenced by cactus hedges to keep the goats in and prevent them from damaging the environment, or rows

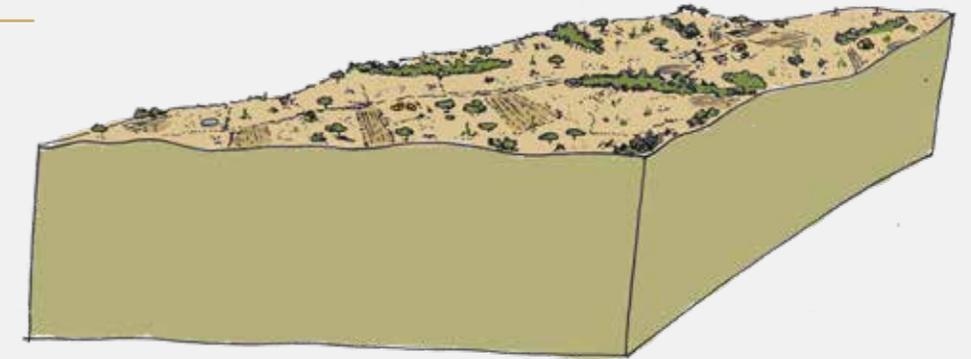
of saddle trees grow around the fields and are used as fence posts. Solitary trees in the fields provide shade to the goats. Fodder for the goats in this area is produced and processed into hay. Fodder is grown in strips, so that the irrigation system can remain in place while sowing and harvesting. Goats produce meat for the consumer market, local restaurants and as high quality export product for the wider Caribbean region. The valuable, soft goat skin is used to produce bags and purses, as well as drumheads. Goat dung is used as fertiliser for fodder production and in horticulture.

Water harvesting in the kunukus, which had largely been abandoned in the 1960s, has been restarted, with water again harvested in strategically located dams and artificial ponds ensuring the availability of additional rainwater in the dry season. To maintain the level of the water table and prevent the natural vegetation from drying out, the use of wells is limited.

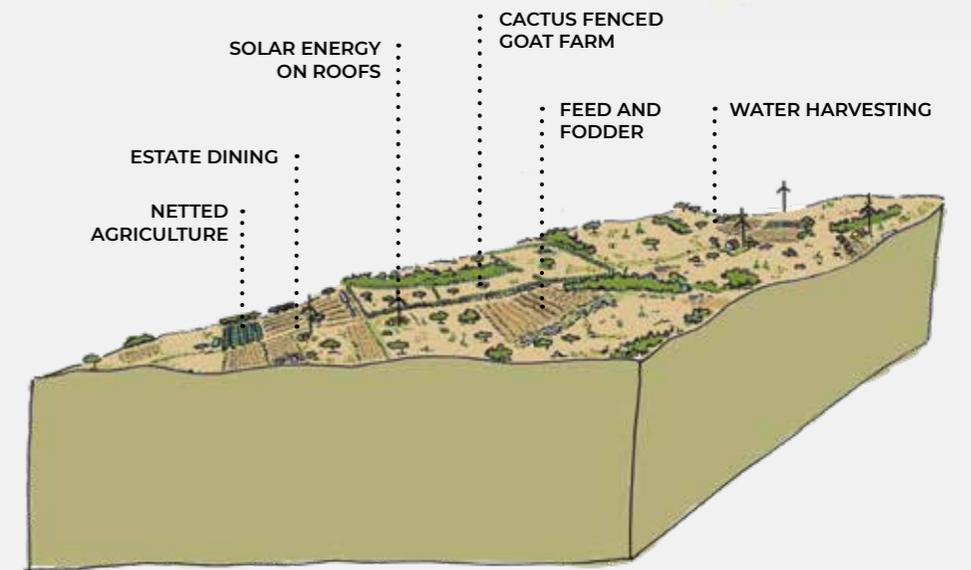
Electricity is produced at sites where it is needed. Solar panels are placed on farm houses and sheds. Yards are provided with a small wind turbine.



## KUNUKU CURRENT LANDSCAPE



## KUNUKU FUTURE LANDSCAPE



# CARIBBEAN SAVANNA

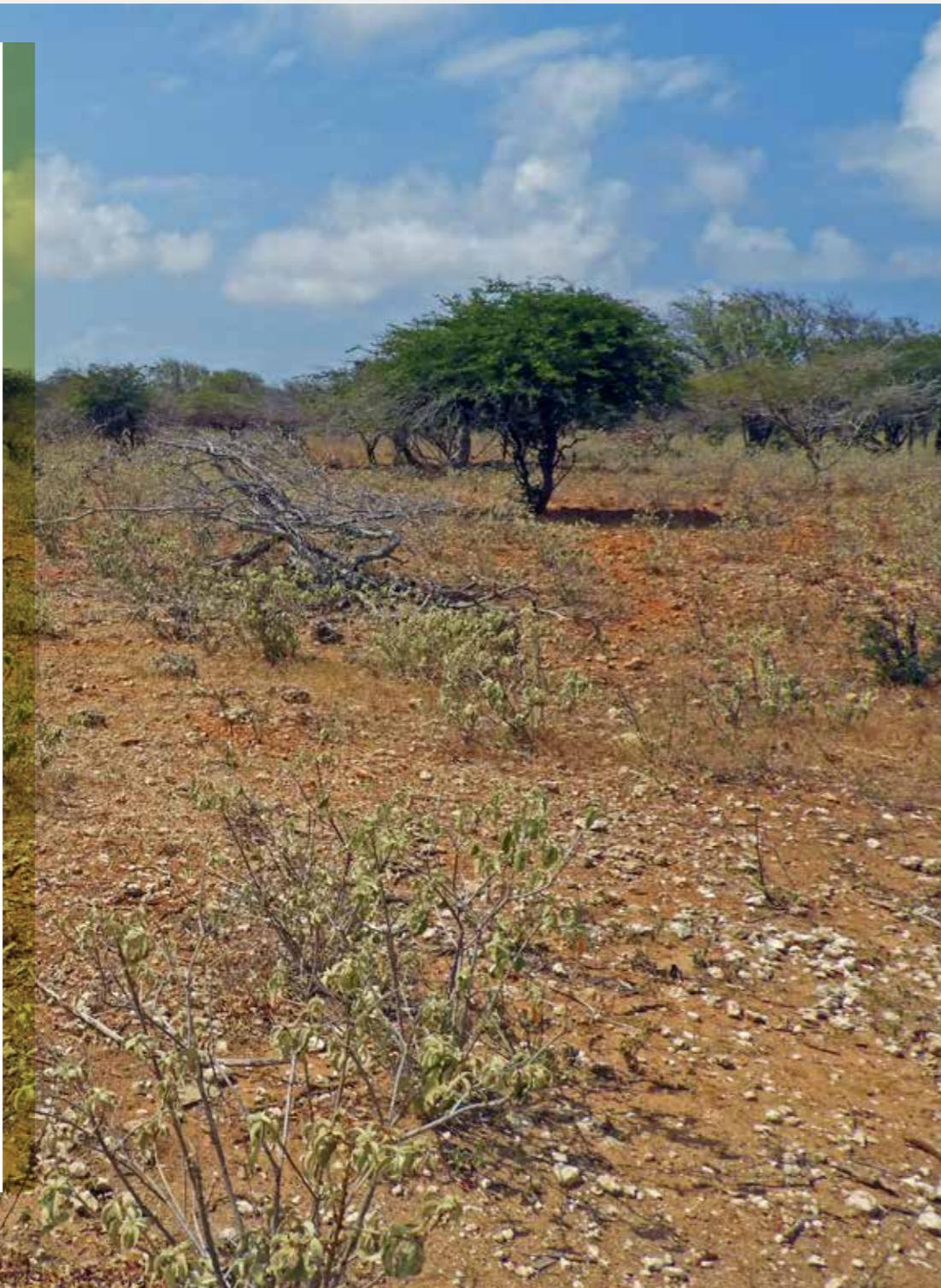
This landscape is part of the former plantation Bolivia connecting the non-urban landscapes of the south with the northern parts of Bonaire. It strongly resembles a savanna landscape, with a dry grassy herbal plain dotted with solitary umbrella shaped trees.

Centuries ago it was densely covered with trees, which disappeared as the result of Brazil wood harvesting (providing the raw material for dye) and Wayaká wood (with self-lubricating characteristics ideal for ship pulleys), charcoal production and extensive free roaming goat husbandry. In addition to horses and mules that were raised for export, this was one of three areas on the island where cows were bred for meat. During the wet season, the cows would graze on pastures ('sabanas') and during the dry season they dwelled in the forested areas.

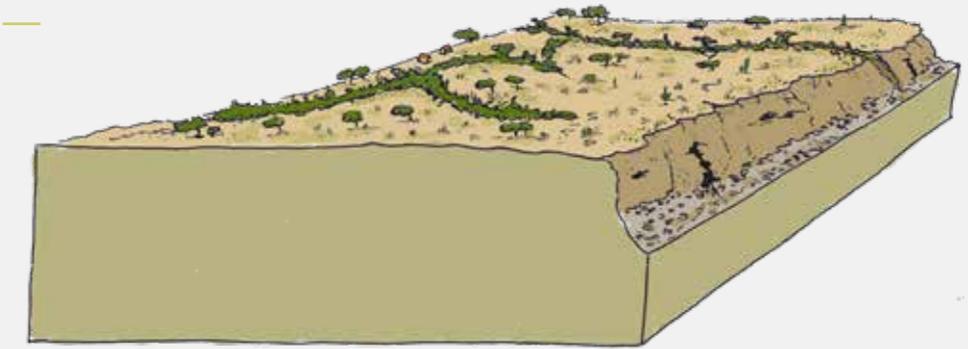
Nowadays, the Caribbean savanna is intersected with dry river beds ('rooien') vegetated with dense thorny shrubs. Old plantation buildings, corrals and fences for livestock and various abandoned wells can be found in the area.

## 2050 VISION

The future vision for the Caribbean savanna is a landscape where feral, free-roaming livestock has been removed to allow the vegetation to naturally develop into a lush dry forest. The rooien, as well as the fringing cliffs at the seaward end of the area, are revegetated to prevent erosion runoff, and consequent sedimentation of the reef off the coast. This revegetation strengthens the habitat for the characteristic wildlife of the dry forest and protects the underlying caves that are home to migratory bats. The area thus forms an unhindered passage for birds, reptiles and insects moving from one side of the island to the other.



CARIBBEAN SAVANNA  
CURRENT LANDSCAPE



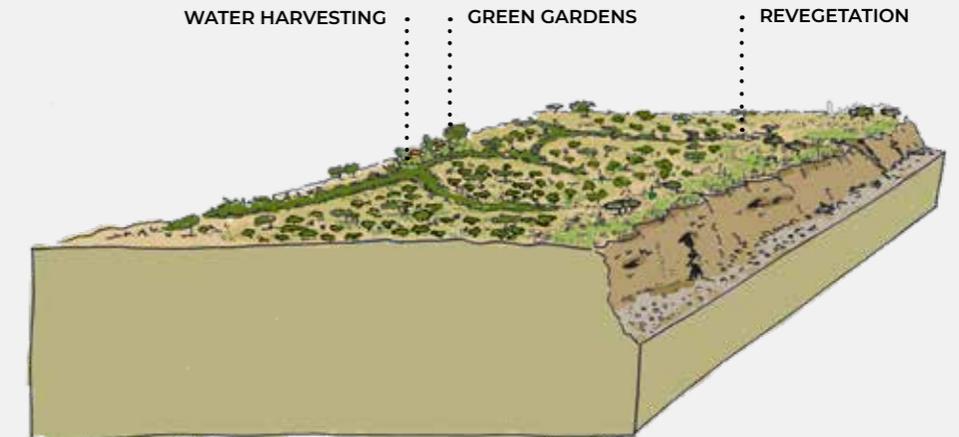
CARIBBEAN SAVANNA  
FUTURE LANDSCAPE



WATER HARVESTING

GREEN GARDENS

REVEGETATION



# WINDSWEPT INHOSPITABLE NORTHEAST COAST

At first sight, the Northeast coast evokes associations of a desolate moon landscape or salt sprayed wasteland, confined between the sea and a rising cliff. Despite this seeming barrenness, the landscape is home to the Turk's cap cactus and nesting ground for the endangered Least tern.

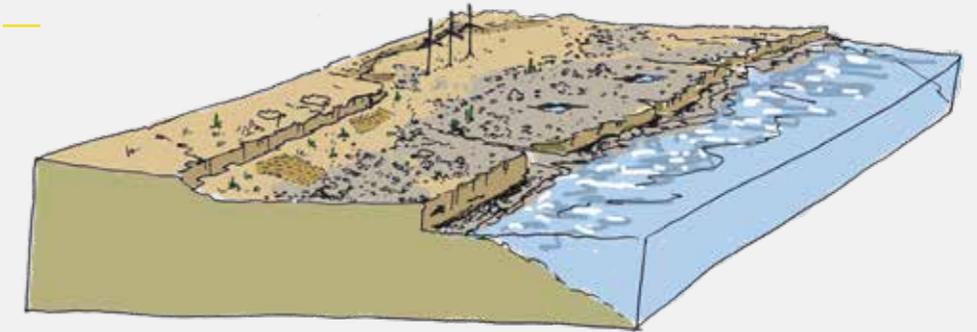
For the Caiquetio Indians, the first inhabitants of Bonaire, the area housed many sacred places, that can still be recognised from cave paintings and oral history. Bats (both migratory and stationary) sleep in these caves during the day and use them to deliver and nurse their young. The coast is characterised by several 'bocas' or small bays, in which dry river beds discharge during the rainy season. A storm berm of coral rubble, sand dunes and boulders is located at some distance behind the intertidal splash zone. In most areas, however, these sand dunes and rubble berms have been mined for use in construction, leaving barren rock.

## 2050 VISION

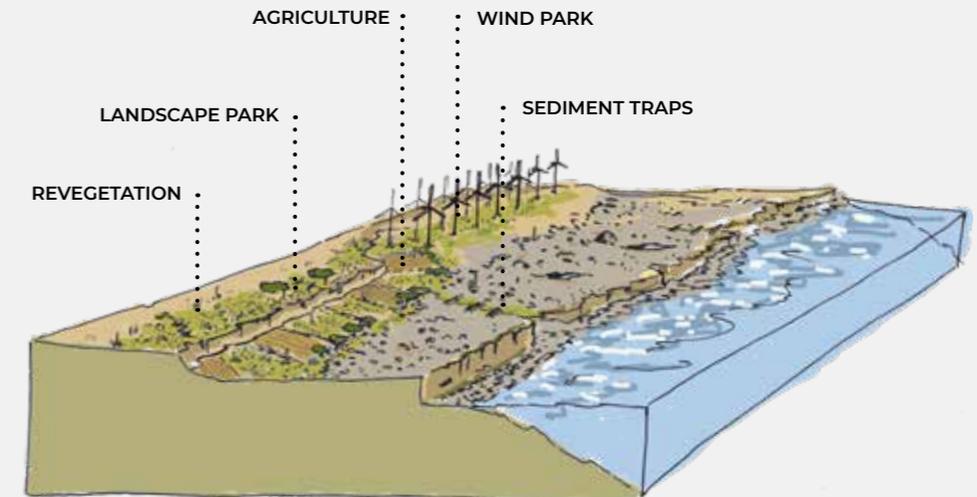
In the landscape park, only pockets of land are in use. Few small parcels of agricultural fields can be found at the base of the cliffs where groundwater seeps to the surface and upstream of the bocas. Here, a patchwork of lush green natural vegetation is found around the rare agricultural plots. Sediment traps capture eroded soil to protect the reef in front of the coast. Wind parks generate a large part of the island's energy. The wind turbines are placed further inland to prevent salt spray damaging the constructions and are located in such a way that they do not hinder bats.



WINDSWEPT INHOSPITABLE NORTHEAST COAST  
CURRENT LANDSCAPE



WINDSWEPT INHOSPITABLE NORTHEAST COAST  
FUTURE LANDSCAPE



# LAC LAGOON

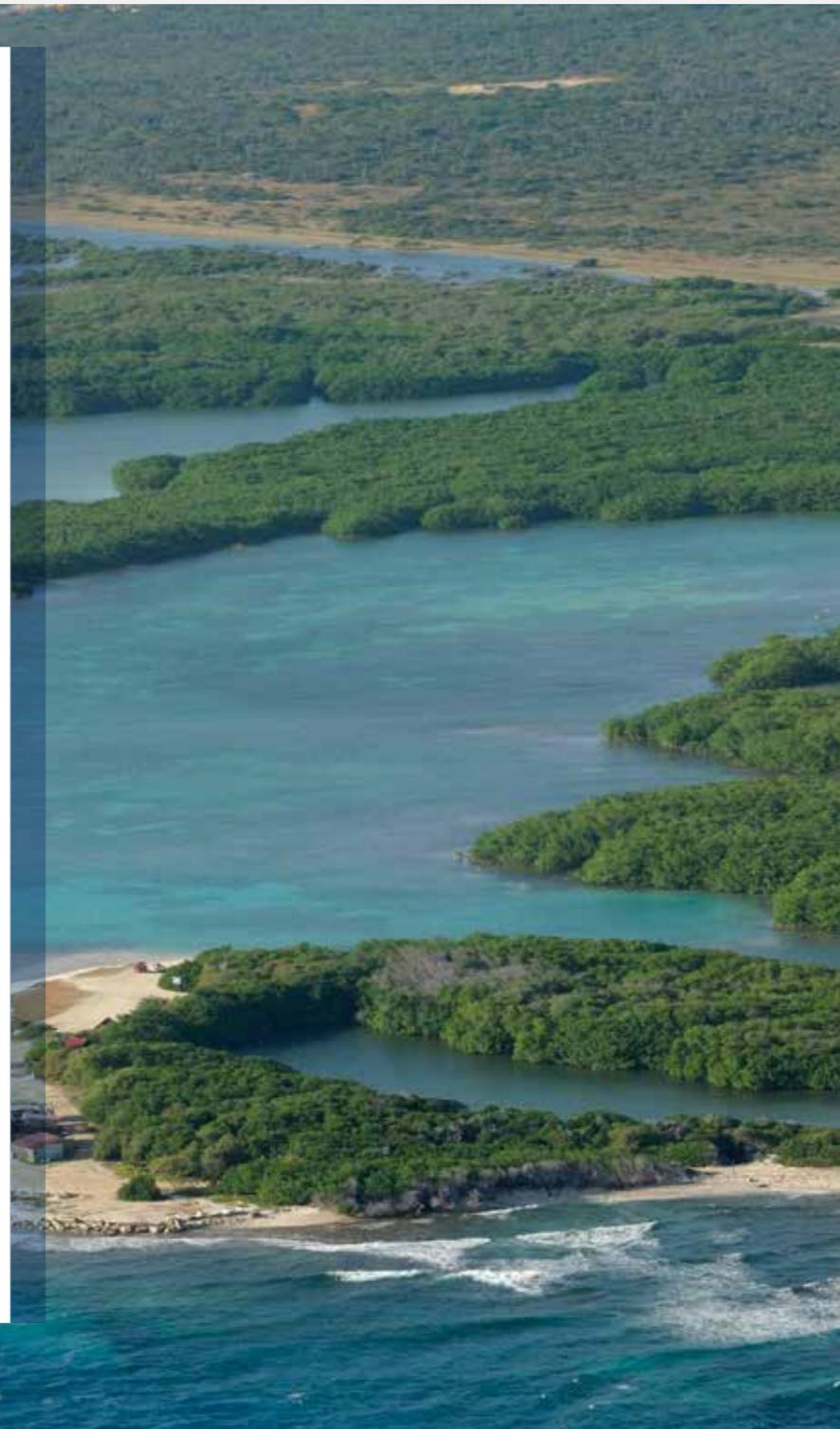
The area of Lac is a sheltered shallow inland bay located on the south-eastern shore of Bonaire and is the island's most significant lagoon. It contains thriving seagrass and algae beds, and healthy and rejuvenating mangroves. Although small-scale, Lac hosts the biggest fishing harbour of the island.

The lagoon is an important nursery site for conch and many species of reef fish. It is also a critical foraging ground for globally endangered juvenile green turtles. Half of the area consists of open water and the other half is separated by a formation of islands that consist of shallow, muddy basins fringed with mangroves. Lac is separated from the ocean by a fringing reef and is recognised as a wetland of international importance. As such, it benefits from special protection. Lac supports large numbers of breeding and wintering shorebirds and seabirds, such as the Magnificent frigatebird and the Caribbean flamingo.

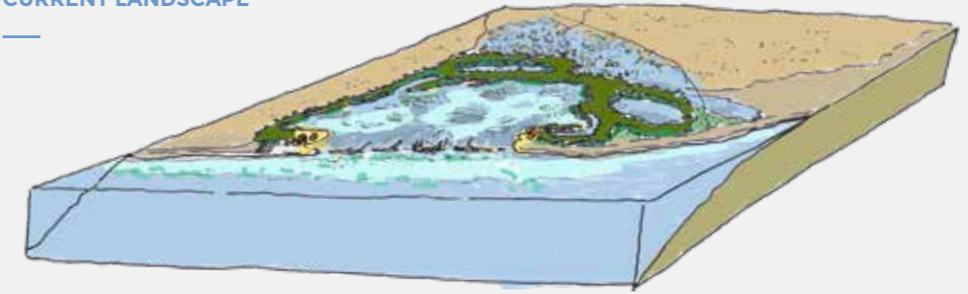
## 2050 VISION

In the vision for this landscape, the area surrounding Lac is free from roaming livestock. North of Lac the natural waterways ('rooien') have been deepened. Moreover, dams from rooi Grandi eastwards have been constructed to prevent surface runoff and allow the fresh water to drain slowly. The collected sediment is transported and used as substrate for agriculture at the kunukus. The north boundary has been reforested to capture soil from the hinterland, that would otherwise discharge into the mangroves and seagrass beds, suffocating life. Within this new forest, shaded picnic spots have been located.

To conserve Lac and prevent the mangroves growing bay-wards, canals have been cut to improve the through-flow. Without these active measures, the mangrove forest would extend into the bay and would die off at the outer edge, leaving a salt plain. Mangroves have also been replanted at the outer edge to capture carbon in the peat substrate. The canals in the mangroves are ideal for kayak tours, where tourists are informed about the unique functioning of the mangroves with their unique wildlife. The seagrass beds have been restored and are restricted from damaging leisure activities, like surfing. Tourism pressure is kept within sustainable limits so that it does not harm the natural environment.



LAC LAGOON  
CURRENT LANDSCAPE



LAC LAGOON  
FUTURE LANDSCAPE



# SOUTHERN FLATS

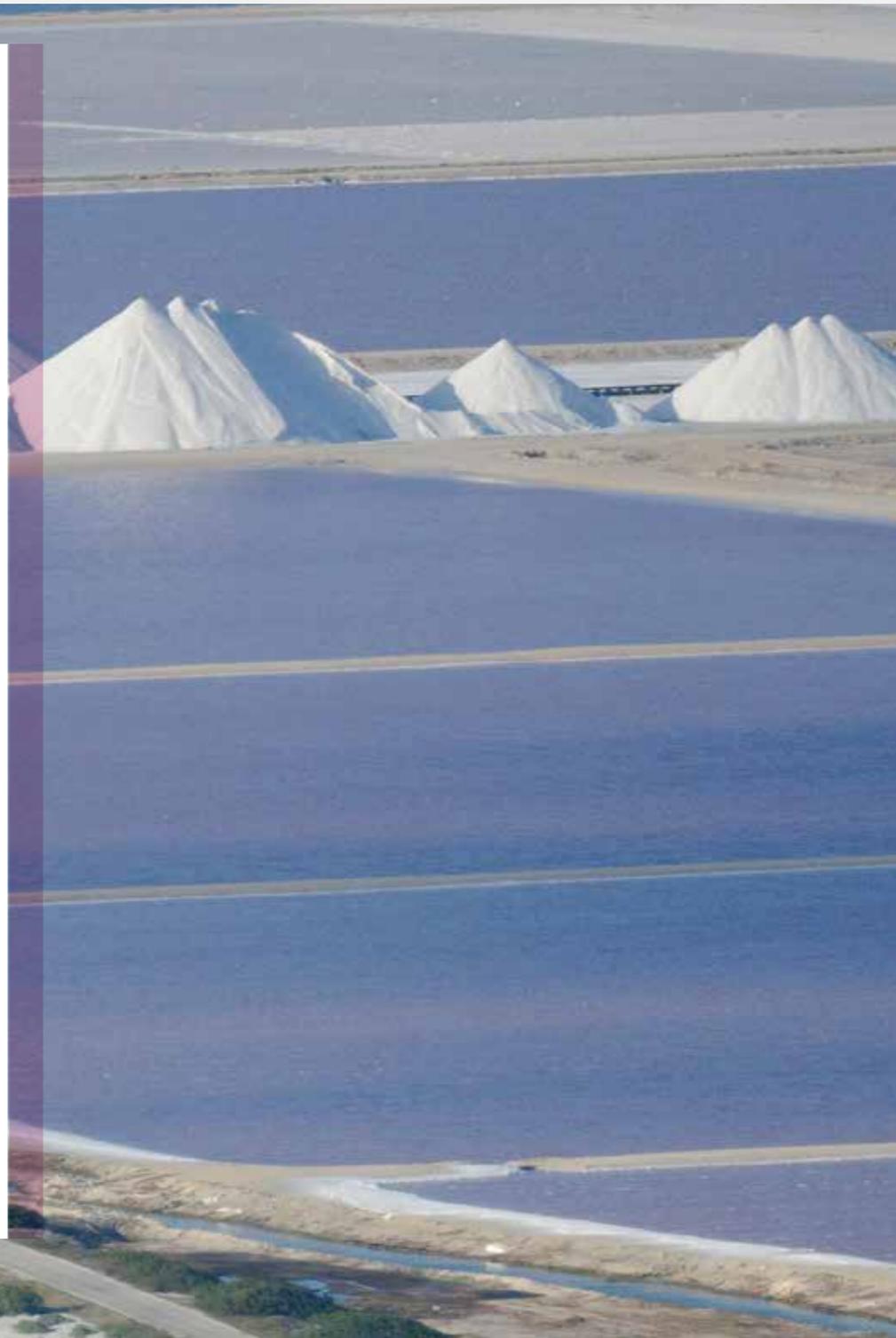
The salt pans cover most of the narrow, sea-level southern end of the island and form an extensive habitat for the unique biodiversity including Bonaire's flagship species the Antillean flamingo, nesting terns and migrating shorebirds as they have done for decades.

Part of this area is actively managed for salt production. Wind mills pump seawater into a series of condenser ponds to increase the salinity of the water. The salt is harvested about once a year from crystallizer ponds. Natural dikes of coral debris surrounded the low lying southern part of Bonaire protecting it from the sea. The natural coral dikes were excavated for building material for houses and as a foundation for road construction in the 1950s. This has substantially increased the coastline's vulnerability to sea storms and flooding.

## 2050 VISION

Direct discharge of industrial effluent is prevented; instead the brine effluent is used for the production of brine shrimp (live food for fish) as a high value commodity export product. In other parts of the area, floating seaweed farms provide the bio-pharmaceutical industry with high-value raw material.

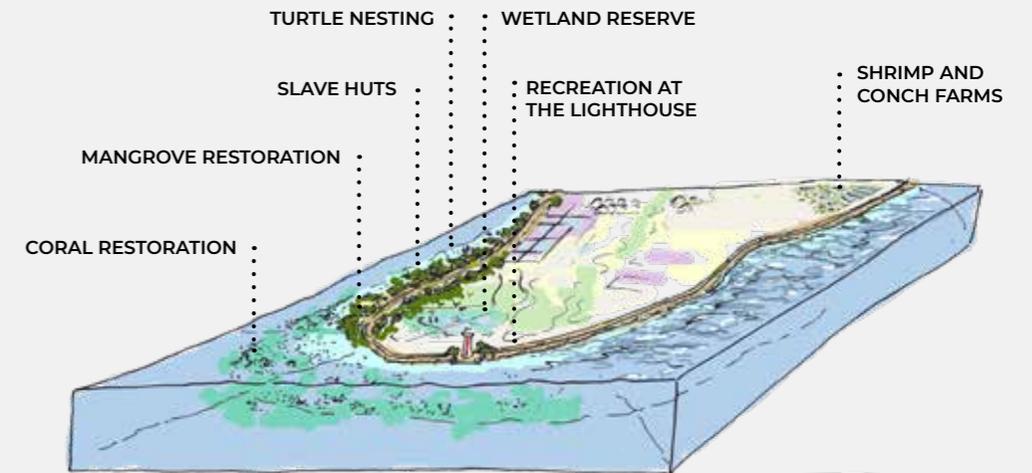
Along the west coast, healthy reefs and lush mangroves protect against sea storms and flooding and grow with the rising sea. This allows the natural reformation of coral debris dikes. On specific locations, tourists are offered a resting place with a magnificent view over the salt mounds, a cultural heritage of slave huts, a lookout for birding or a diving spot. Existing infrastructure and buildings have been pulled back from the coastline, to reduce their vulnerability to damage from sea storms and flooding. This also provides the opportunity for making the entire shoreline publicly and freely accessible to everyone, except for pockets of habitat for nesting sea-turtles and seabirds. Just south of the Lac Lagoon landscape, shrimp and conch are grown in special aquaculture facilities.



## SOUTHERN FLATS CURRENT LANDSCAPE



## SOUTHERN FLATS FUTURE LANDSCAPE



# SCRUBBY SOUTHERN LIMESTONE PAVEMENT

The rock-hard calcareous substrate, strong winds, and salt blown in from the sea makes this area inhospitable for human activities. Scrubby plants and cacti grow in the holes and cracks in the limestone pavement, as well as the indigenous and iconic Sabal palm, native solely to Bonaire. In the dry season, shrubs drop their leaves on the volcanic soils while this area bursts with berry carrying plants, attracting songbirds.

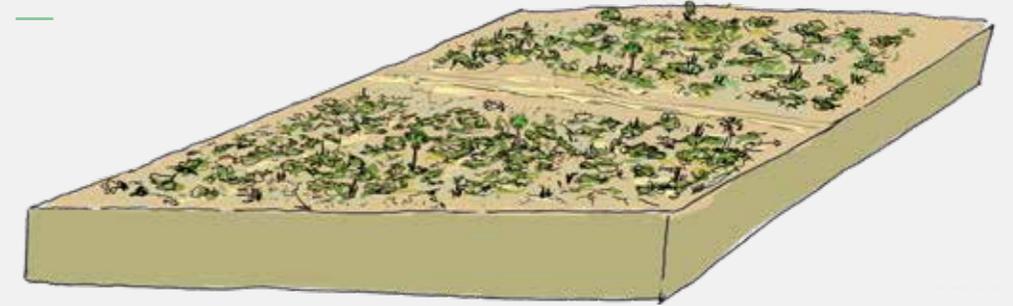
## 2050 VISION

Conservation efforts have been put into place to protect this landscape from feral herbivores. Fences have been installed to give new Sabal palms a chance to grow and to keep free roaming livestock outside of the entire area. In addition, a large number of palms have been successfully cultivated and replanted in the area to help expand the population. This landscape type harbors a large, sustainable population of Sabal palm in a well-developed forest and shrub vegetation, that also hosts extensive populations of bird, reptile and insect species and forms an important sink for carbon.

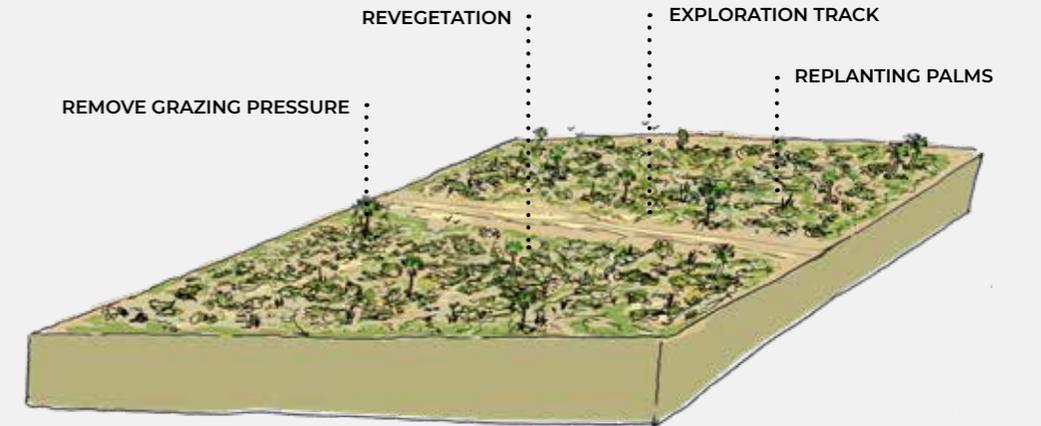
A hiking trail enables exploration of the area, but entrance is restricted to tours lead by local guides from the nearby villages.



SCRUBBY SOUTHERN LIMESTONE PAVEMENT  
CURRENT LANDSCAPE



SCRUBBY SOUTHERN LIMESTONE PAVEMENT  
FUTURE LANDSCAPE



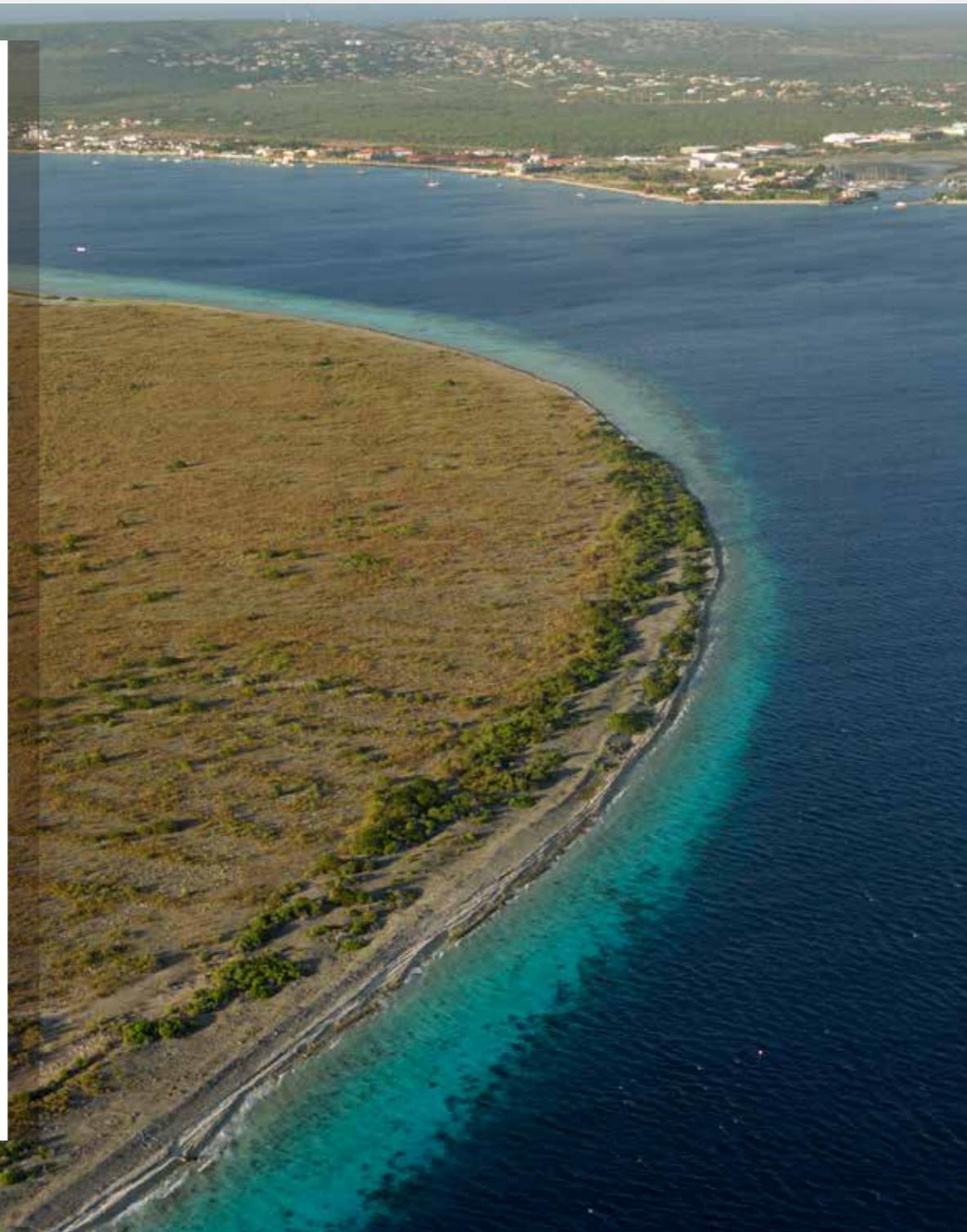
# UNOCCUPIED ISLAND OF KLEIN BONAIRE

The small offshore island of Klein Bonaire is located approximately 750 metres off the central west coast of Bonaire, separated by a strait of almost 200 meters deep. It is a low sandy coral-limestone island fringed by reefs that support an extremely rich variety of marine fauna.

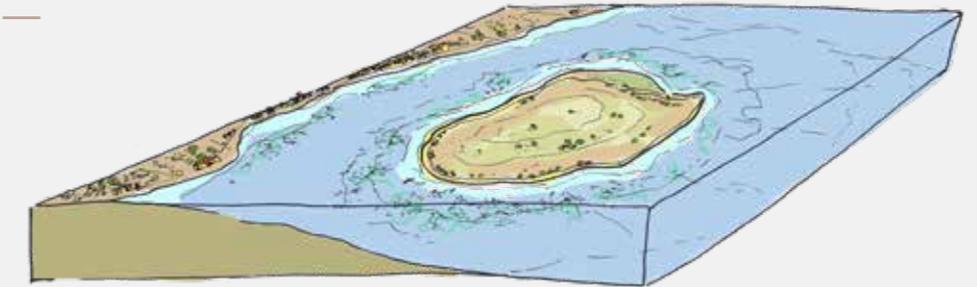
The total land area of approximately 6 km<sup>2</sup> includes salinas, freshwater wells and sandy beaches. These beaches are vital nesting areas for sea turtles. The island is a stop-over point for countless species of migratory wetland birds, and an important breeding site for terns. In the past, Klein Bonaire was covered with forest. Years of logging, devastating storms and all-plant devouring goats cleared the island completely. The eradication of goats since the 1980s and active replanting of indigenous trees has initiated the recovery of the island's vegetation. The island is uninhabited but people visit the island daily, mostly for picnics, for snorkelling, diving, birding, hiking and sea turtle conservation activities.

## 2050 VISION

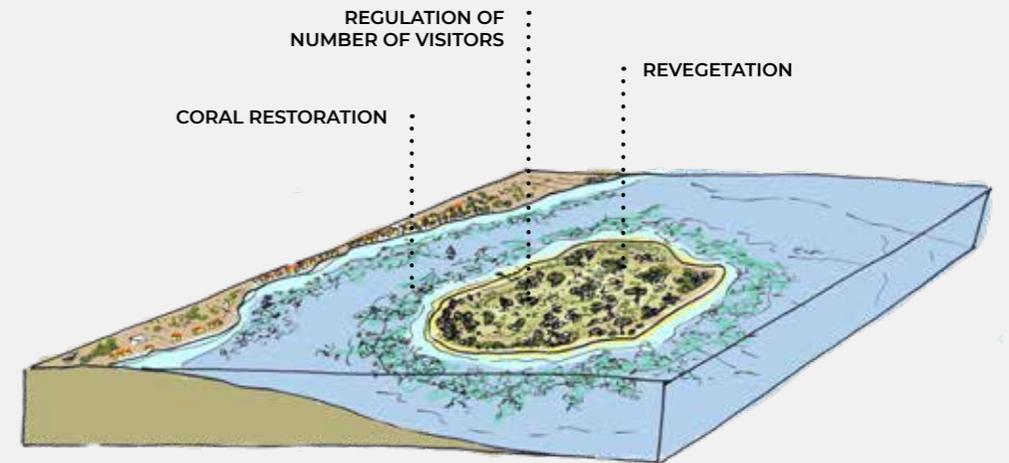
The original forest is close to being fully restored as a result of ongoing revegetation activities. The fringing reefs are actively being restored. The number of visitors to the island are regulated to limit disturbance to animals (e.g. birds and turtles) and habitats (e.g. reef), and to enjoy it's peaceful ambiance and unsurpassed natural beauty.



UNOCCUPIED ISLAND OF KLEIN BONAIRE  
CURRENT LANDSCAPE



UNOCCUPIED ISLAND OF KLEIN BONAIRE  
FUTURE LANDSCAPE



## NEXT STEPS

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### STIMULATING UPTAKE AND IMPACT

Bonaire is and has always been a natural beauty. Perhaps this booklet has shown you (once again) how special Bonaire is and has inspired you to think about its future. The vision for Bonaire can also be used to inspire small tropical islands all over the world.

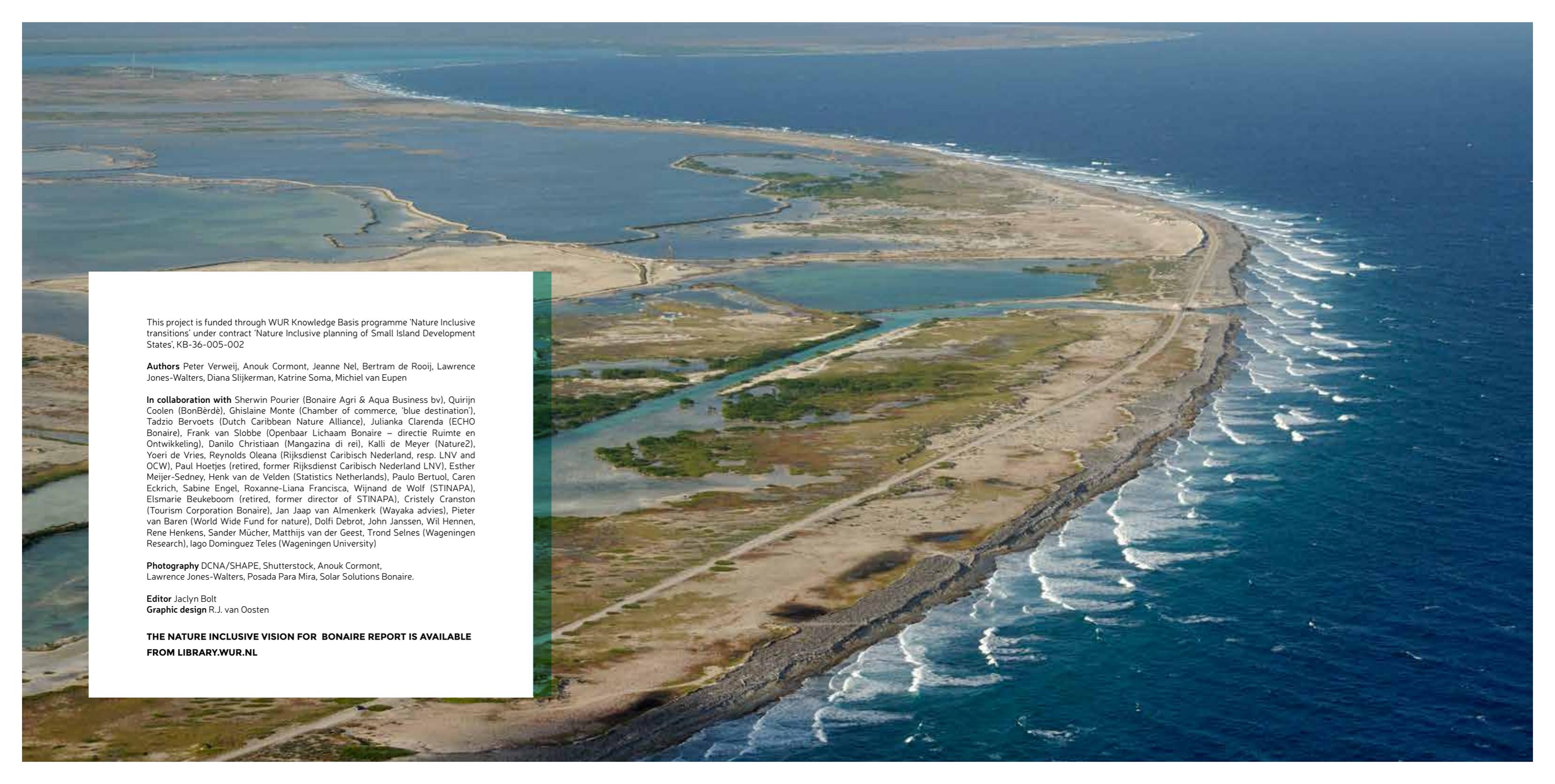
The work behind this book is ongoing. We will keep incorporating the knowledge of a growing group of island experts over time. We endeavour to catalyse the implementation of nature inclusive measures that have been collectively identified. The approach embraces the feedback of the islanders. An example is to look for specific suitable locations for nature inclusive measures. Or to further investigate how much economic growth can be generated from local food production. Aside from theoretic research, Bonairians may decide they want to develop

several micro-scale example projects. Another option is to choose champions who can promote the transition to a nature inclusive society. A combination of these suggestions is also possible.

Many island experts and decision-makers have linked their knowledge about nature, agriculture, recreation, culture, and governance to inform this vision. These people were excited to join the different design sessions, interviews and workshops. They expressed the wish to include 'nature inclusiveness' in their own ongoing initiatives. Maybe it has inspired you to join initiatives that already exist on the island, such as the collection of rainwater, instalment of solar panels, or greening of your garden. Perhaps you have been encouraged to start your own nature inclusive actions.



WITH THE KNOWLEDGE OF ISLAND EXPERTS AND  
DECISION MAKERS, AND THE ENTHUSIASM  
OF THE LOCAL COMMUNITY, WE CAN CREATE A  
BEAUTIFUL BONAIRE FOR GENERATIONS TO COME



This project is funded through WUR Knowledge Basis programme 'Nature Inclusive transitions' under contract 'Nature Inclusive planning of Small Island Development States', KB-36-005-002

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regulating wells  
Why here? **Around Karuku Grounds**  
WAGENINGEN

inland tourism  
Why here? **improve income strength traditional culture**  
WAGENINGEN

windparks  
Why here? **expansion of current one.**  
WAGENINGEN

windparks  
Why here? **expansion of current one.**  
WAGENINGEN

trees for  
Why here? **improve microclimate**  
WAGENINGEN

greening gardens  
Why here? **So people can have Fresh Food**  
WAGENINGEN

housing  
WAGENINGEN

Unesco  
WAGENINGEN

zoning  
Why here? **Unesco Heritage site.**  
WAGENINGEN

re-vegetation  
Why here? **re-vegetation**  
WAGENINGEN

trees for shade  
Why here? **for cool**  
WAGENINGEN

Establish Native park  
WAGENINGEN

sediment traps  
Why here? **sediment traps**  
WAGENINGEN

floating farms  
Why here? **because IS no place only UK**  
WAGENINGEN

WG  
WAGENINGEN

greening gardens  
Why here? **greening gardens**  
WAGENINGEN

storm water harvesting  
Why here? **sedimentation reduction improve storm water**  
WAGENINGEN

trees for shadow  
Why here? **to shade + cool**  
WAGENINGEN

trees for shadow to cool urban areas  
Why here? **to cool urban areas**  
WAGENINGEN