



# Collaboration between Wageningen University & Research and the Caribbean



**WAGENINGEN**  
UNIVERSITY & RESEARCH



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# Preface

As rector magnificus of Wageningen University I'm very proud that we're able to show in this booklet the projects experts and scientist of Wageningen University & Research (WUR) are implementing in the Caribbean. The Netherlands itself has a strong and dynamic relation with the region specifically with the countries of the Kingdom of the Netherlands (Aruba, Curaçao and Sint Maarten) as well as with Surinam. In 1967 Wageningen University established the Centre for Agriculture Research in Surinam, as a branch of the Agriculture College of Wageningen. The centre now still carries out research in Agriculture and Forestry and is an important reference centre in the country, currently under the Dirección of an Alumna of Wageningen University.

Personally, I have been engaged regularly with the Caribbean as well as with Surinam. I have been the co-author of books investigating the challenges of environmental management in Curaçao (1997) and Surinam (2004). And in 2014 I was promotor of a PhD research on climate change and Caribbean tourism, specifically on the modelling of adaptation and vulnerability. I have always been fascinated by the huge challenges small island development states (SIDS) in the Caribbean face regarding sustainability and climate change. And how these environmental challenges interfere with others: economic crises, inequalities, earthquakes, hurricanes, sargassum blooms, boycotts, Covid-19, to name just a few. Against these huge and interdependent challenges small island developmental states have limited capacities to cope with them, which only increase the necessity of collaboration.

With this booklet Wageningen University & Research offers a selection of WUR expertise that might be – and sometimes has been – of help to the region in facing these complex challenges, as well as in creating opportunities and innovations that strengthens each and every island in a sustainable development path. Wageningen University & Research, as the leading global university in agriculture, food and the environment, is eager to strengthen existing and establish new partnerships in the Caribbean to support sustainable development and solid and resilient water, food and environmental management systems for each and every island.



Prof. dr. ir. Arthur P.J. Mol  
*Rector Magnificus of Wageningen University and Vice-President  
Executive Board of Wageningen University & Research*



\* Mexican, Colombian and Venezuelan students have not been included in this map, because the main part of these students are from inland (not from the Caribbean coast)

# Atlantic Ocean



## Introduction

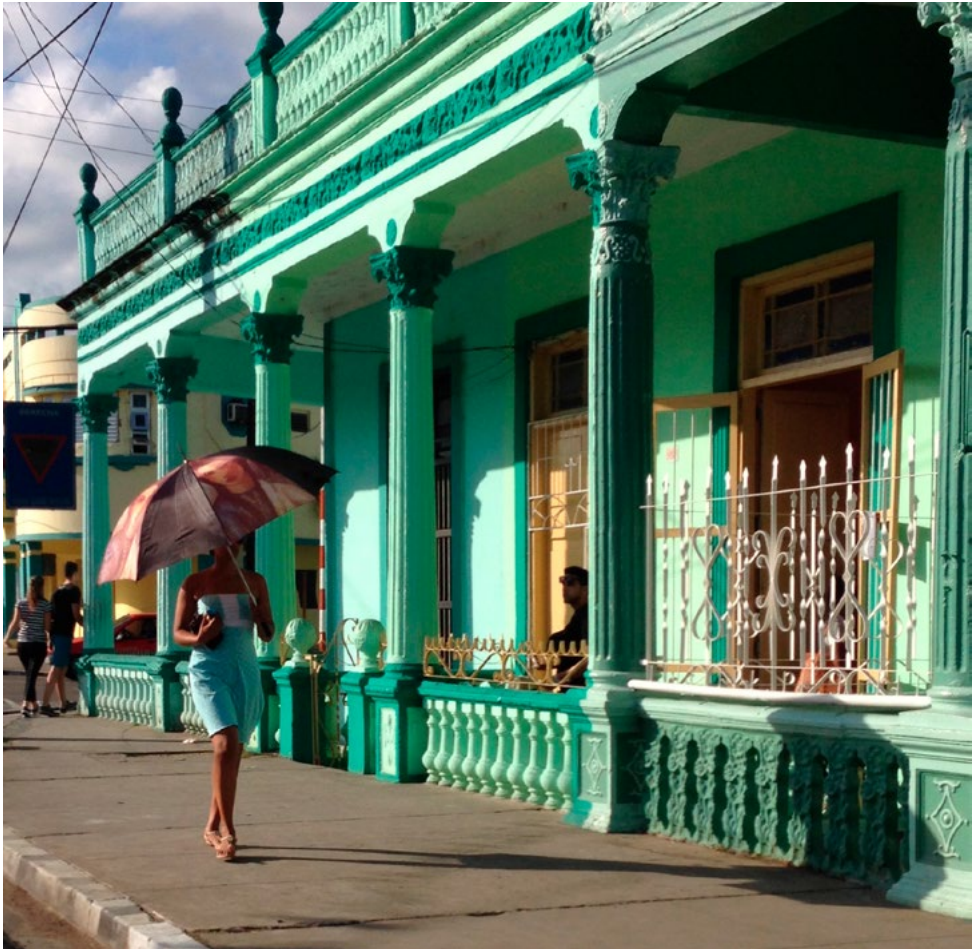
The Caribbean is a region in the Americas with islands and coasts bordering the Caribbean sea. Three countries of the Kingdom of the Netherlands (Aruba, Curaçao and Sint Maarten) and the three special municipalities Bonaire, Saba and Sint Eustatius are placed in the Caribbean and main the reason why Wageningen University & Research has been and is doing quiet some research in the Caribbean. Also still a historic and dynamic relation with Surinam exist and the new government and the easiness of sharing a common language created new opportunities with ministries, research institutes and the University of Anton de Kom in Surinam.

In the second half of 2022 visits of several WUR experts to other Caribbean islands are foreseen and beginning 2023 WUR expects to come up with a strategy to work on specific topics with partners in the Caribbean in the framework of challenges faced by Small Island Development State. This booklet is a first step and offers you an overview of the research of WUR in the Caribbean. Apart from the projects in the Dutch Caribbean (on for example ecology of the valorisation of Sargassum) it shows you work on food security in Cuba and fruit quality in Haiti as well as marine research under water on corals, sea turtles and sharks.

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# Students

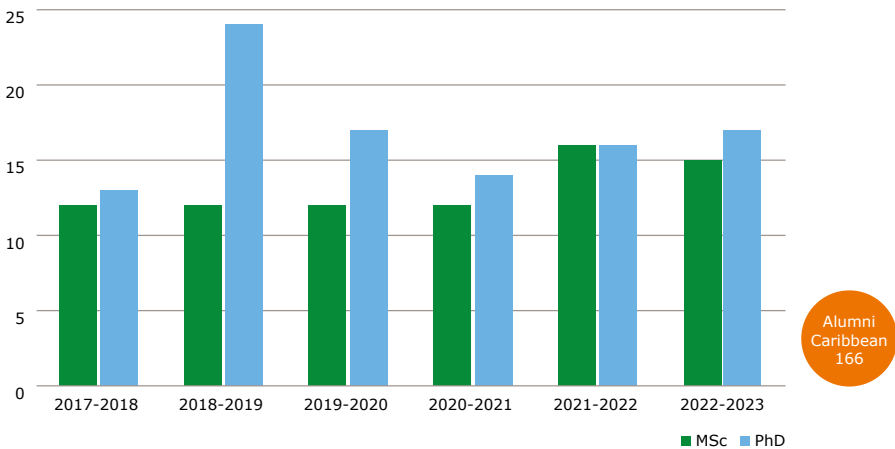
In this academic year 2022-2023, Wageningen University & Research has 40 students from the Caribbean: 8 BSc, 15 MSc students and 17 PhD candidates. In 2021 we counted 166 alumni from the Caribbean who have graduated from Wageningen University & Research.

Student numbers Caribbean (total) of the following countries:

- Surinam
- Costa Rica
- Panama
- Cuba
- Honduras
- Trinidad & Tobago
- Nicaragua
- Jamaica
- Barbados
- Puerto Rico
- Saint Kitts and Nevis
- Cayman Islands
- French Guiana

\* *Mexican, Colombian and Venezuelan students have not been included in this list, because the main part of these students are from inland (not from the Caribbean coast)*

\*\* *Students from the Caribbean Netherlands (Bonaire, Statia, Saba), Aruba, Curaçao and Sint Maarten are most likely being registered with their Dutch nationality for which it is not clear how many students Wageningen University has from these islands.*



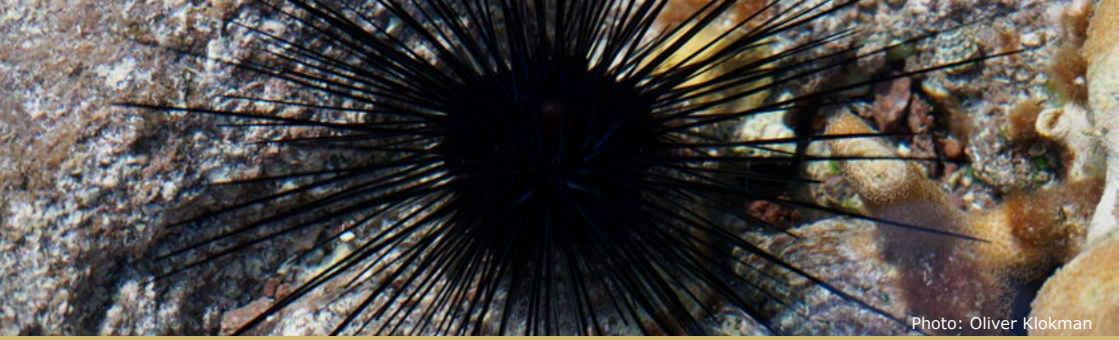


Photo: Oliver Klokman

## Diadema: key to healthy coral reefs

From 2019 - 2023 | Total budget € 700,000

The RAAK PRO Diadema project aims to restore long spined sea urchin populations (scientific name *Diadema antillarum*) on the coral reefs around Saba and St. Eustatius. Long spined sea urchins were the most important herbivores on Caribbean coral reefs.

In 1983, more than 95% of the sea urchins died, due to an unknown disease. Without the grazing sea urchins, the algae were no longer consumed and increased in abundance, smothering adult corals and inhibiting the settlement of juvenile corals. As a result, the reef became covered with algae instead of corals. Nowadays, more than 35 years after the die-off, long spined sea urchins are still very rare. They are sometimes abundant in shallow waters, such as harbors, but are seldom seen on the deeper coral reef. University of Applied Sciences Van Hall Larenstein and Wageningen University & Research work together with local partners on the RAAK PRO Diadema project. The overall aim of the project is to develop active intervention methods to restore the populations of this important herbivore. The project is funded by the Dutch Organisation for Scientific Research (NWO).

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### More information

<http://www.vhluniversity.com/diadema-en>

### Contact

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# Sustainable and circular organic waste and sargassum management on Bonaire (boncirc)

From 2022-2024 | Total budget € 900,000

In the BONCIRC project circular approaches to sustainable management of organic waste streams in the Dutch Caribbean, using Bonaire as a case study will be developed. At Bonaire, organic waste is collected jointly with other waste and mostly landfilled. This causes GHG emissions, nutrient leakage and eutrophication of natural environments and the coastal habitat. The biomass collected from the Sargassum seaweed influxes, that cause severe environmental damage in the coastal ecosystems, will be incorporated to the waste streams. During the project, organic residues and wastes (food waste, agricultural residues, manure, garden waste, Sargassum, etc.) are mapped and assessed in terms of amounts over the year, composition, current uses and potential uses, circularity of current uses and expected development over time. Uses of sargassum biomass, that currently is disposed of, will be studied in combination with other organic wastes thereby creating (more) circular value-chains that contribute to regenerating natural (marine) habitats and agriculture. Because of the diversity of wastes, several applications will be studied: 1) Direct applications for food/feed products, 2) Applications of (mixed) organic waste streams, digestate from anaerobic digestion and wastewater as substrate for compost or soil enhancers (reducing imports) and 3) The production of biogas (for electricity generation, replacing fossil diesel) and digestate based compost from the organic wastes and Sargassum.

Acknowledgement: This project was financed by the Dutch TKI- Agri & Food programme, with project nr LWV21.204

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## More information

<https://doi.org/10.18174/543797>

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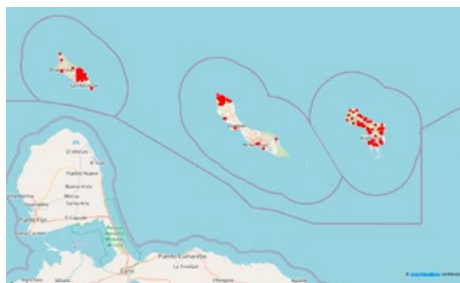
# Distribution of vascular plants on the Dutch Caribbean islands

From 2020-2022 | Total budget € 40,000

Ecosystems on the Dutch Caribbean are under threat due to climate change, urbanisation, change of land use and invasive species. Detailed knowledge on the distribution of vascular plants is crucial for conservation and sustainable land use. However, data on the distribution of plants on the Dutch Caribbean are scarce, which is typical for tropical ecosystems. In addition, large amounts of available distribution data have not yet been digitised. The lack of available data hampers conservation efforts and decision making on land use.

The project foresees the construction of an updated species list of vascular plants and the digitization of approx. 50,000 plant records retrieved from vegetation surveys, inventories, literature, apps, photo archives and herbarium records. All data will be presented on a grid base through an interactive web-server on the Dutch Caribbean Biodiversity Database website ([www.dcbd.nl](http://www.dcbd.nl)) and will be uploaded to GBIF. The resulting distribution maps will indicate threatened species and areas of conservation interest.

The project is carried out in close co-operation with Carmabi (Curaçao). Local partners on the islands are involved, including governments, national park agencies and private persons. Others are invited to contribute data such as photos, digital observations or reports with plant inventories.



## More information

[speciesdistribution.dcbd.nl](mailto:speciesdistribution.dcbd.nl)

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# Connecting Cuban farmers to the Network of Lighthouse Farms

From 2021-2023 | Total budget € 32,999

Cuba's agricultural model is characterised by strong centralised planning and control, leading to limited (inter)national cooperation and restricted access to the international market. This limits farmer's autonomy in access to inputs and sales markets, but also constrains sharing and exchanging knowledge and experiences through (intern)national networks and cooperation.

Yet, a number of entrepreneurial farming initiatives, known for their high level of innovation with a vision to provide agroecologically produced food for the local population is growing. These initiatives demonstrate that agroecological farms are economically viable production models that may contribute to food security in a sustainable way. Learnings from the Global Networks of Lighthouse Farms indicate that one powerful mechanism to support the exchange and spread of innovations is through exchange networks. The network provides a clear channel for (inter)national cooperation, and a clear pathway to amplify innovations to the wider farming community.

This project will enable outstanding entrepreneurial initiatives in Cuba to further grow in their knowhow by connecting them with internationally renowned initiatives via the Global Network of Lighthouse Farms and support the creation of Cuba's own lighthouse network.

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Photo: Guido Leurs

# Movement ecology of Reef Sharks

From 2021-2025 | Total budget € 160,000

This BO-43 research for the Dutch Ministry of Agriculture, Nature and Food Quality focuses on studying habitat use and movement patterns of coral reef associated sharks in the Caribbean parts of the Kingdom of the Netherlands. During 2014-2020 an operational network of 32+ detection stations was build that enables to follow individual shark behaviour with acoustic transmitters. This network will be used for this follow-up study that started in 2021. Different species of sharks (namely Caribbean Reef Sharks, Nurse Shark and Silky Sharks) will be deployed with transmitters with sensors to measure habitat use, individual home ranges and the importance of connectivity between different coral reef systems in close cooperation with local NGOs, park managers and dive operators. Because tagged sharks can be tracked during more than 4 years, the main analysis will take place in the last years of the project. The data and acquired knowledge will be used to indicate health of coral reefs and fisheries, determine what (key)habitats are, evaluate conservation zones (local marine parks and the large shark and whale sanctuary YARARI) and furthermore enhance local support and awareness for protection of sharks.

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## More information

[www.wur.nl/en/article/nature-research-in-the-caribbean-netherlands.htm](http://www.wur.nl/en/article/nature-research-in-the-caribbean-netherlands.htm)

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# Restoration of Resilience of Nature and Society in the Caribbean Netherlands

From 2021-2024 | Total budget € 1,800,000

The Caribbean Netherlands' marine nature, with its unique coral reef ecosystems, is the most important economic resource for Bonaire, Saba, and St. Eustatius. However, these coral ecosystems are under tremendous pressure due to global ( e.g., climate change) and local (e.g. tourism, erosion, water use, pollution and chronic eutrophication) stressors. Therefore, balancing fisheries, agriculture, tourism, and water management with the natural capacity of the relevant ecosystems is an urgent policy aim for the Dutch Caribbean. Integrated approaches are indispensable to restore such balance through targeted interventions and increase the resilience of nature, biodiversity and thus also of society.

There is a lack of fundamental knowledge and an integrated approach to coastal management in the Caribbean Netherlands. Therefore the current project aims to set up new infrastructures to address this shortcoming. By applying novel (e.g., eDNA, metabolomics, remote sensing, and passive sampling), traditional (e.g., water quality parameters, isotope analysis, digital evaluation models, bathymetry data) and smart technologies (e.g., AI-based data processing and underwater drones), in concert, this project will ultimately provide better insights into which policy can more effectively restore and safeguard nature and the services it provides.

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## More information

[www.wur.nl/en/Research-Results/Research-funded-by-the-Ministry-of-LNV/Expertisegebieden/kennisonline/Restoration-of-resilience-Dutch-Caribbean.htm](http://www.wur.nl/en/Research-Results/Research-funded-by-the-Ministry-of-LNV/Expertisegebieden/kennisonline/Restoration-of-resilience-Dutch-Caribbean.htm)

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# Microalgae cultivation on Bonaire

From 2017-2022 | Total budget € 800,000

Microalgal biomass can be used for food, feed, and biofuels. To grow these microalgae efficiently we need high light levels. Bonaire was chosen as a pilot location as this Caribbean island offers such light levels, all year round. In addition, cultivation of microalgae can benefit the island by creating possibilities for producing food locally, instead of importing it.

In this project we focus on setting up a microalgae production process, designed for the climate conditions of Bonaire. One challenge here is the high temperature that production systems reach due to the high light levels. Cooling is expensive and climate unfriendly, and should therefore be avoided. Therefore, we use indigenous thermo-tolerant microalgal species which do not require cooling. We try to understand how these species can cope with high temperature. In addition, we designed a novel production system which utilises light dilution and passive temperature buffering to prevent overheating. The project was conducted by the group of Bioprocess Engineering at WUR. Funding was provided by the Dutch Research Council (NWO) within NWO Caribbean Programm with project number ALWCA.2016.029.

An example of a project description at the other page (comes from the Colombian booklet that we made before)

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## More information

[www.wur.nl/en/article/algae-grow-better-on-bonaire.htm](http://www.wur.nl/en/article/algae-grow-better-on-bonaire.htm)

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## Assisting Haitian fruit smallholders

From 2017-2021 | Total budget € 400,000

In Haiti a start has been made to change the mango and avocado harvest and transport system and to obtain better prices for small farmers. Experts from the Wageningen Centre for Development Innovation and Wageningen Food & Biobased Research enabled this by providing technical advice, by bringing chain parties together and by introducing greater transparency in the chain. The project is implemented by the Ministry of Industry and Trade, funded by the WB.

Haitian Mangos sell for two dollars in American supermarkets, two to five cents of which go to the farmers. The project's role is to trigger the system to become more sustainable, more transparent and more inclusive for farmers. A better system will give farmers the financial scope to make small investments in the further development of the sector. The development of postharvest Standard Operational Procedures form the basis for the project. These were formulated and tested and provide data on time, temperature and transport, to be used for blockchain or other chain information applications. Significant improvements can be made to the logistical handling of mangos with a few relatively simple steps. The application of blockchain enables farmers to remain owner of their fruits until final B2B sale in the US and the trader to be replaced by a Logistical Service Provider.

This system ensures transparency for consumers and can therefore be regarded as a new form of fair trade. It also gives farmers the opportunity to remain the owner of the products until they are sold to supermarkets. Currently WUR is advising on the design of mobile packing units for tropical fruits, which are expected to be tested in the second half of 2021.

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### More information

[www.youtube.com/watch?v=xpKe8J2i0Wo](https://www.youtube.com/watch?v=xpKe8J2i0Wo)

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# INREEF: Building resilience of marine protected areas in tourism destinations

From 2021-2027 | Total budget € 1,200,000 + 1,000,000 co-funding

Increasing evidence shows that the resilience of coral reefs can be strengthened by adaptive management strategies that reduce local stressors. In a collaborative effort, we identify and develop the tools to analyze how the resilience of Marine Protected Areas (MPAs) can be (i) measured, (ii) monitored, and (iii) governed to safeguard the coral reefs in a future of fluctuating tourism and climate change. MPAs consist of interlinked ecosystems, socioeconomic systems, and governance arrangements, that require an interdisciplinary approach to fully grasp the complex feedbacks.

Our program builds on a strong network of international and transdisciplinary partnerships with 9 knowledge institutions, 8 NGOs involved in MPA management, 6 governmental institutions and 7 parties from the private sector in the Dutch Caribbean and Indonesia. Output:

- Interdisciplinary online education and training programmes
- MPA resilience dashboard to provide 1. comprehensive overview of the MPA status, 2. decision support tool for adaptive management, 3. publicly accessible tool for awareness building
- Governance toolbox evaluating ecological and socio-economic impacts of management strategies and informing on effectiveness and efficiency of policy interventions.
- Technological interventions for wastewater pollution

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## More information

[www.wur.nl/en/Research-Results/Research-Institutes/marine-research/show-marine/INREEF-Interdisciplinary-program-to-build-the-resilience-of-marine-protected-areas-in-tourism-destinations.htm](http://www.wur.nl/en/Research-Results/Research-Institutes/marine-research/show-marine/INREEF-Interdisciplinary-program-to-build-the-resilience-of-marine-protected-areas-in-tourism-destinations.htm)

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# Global wildlife loss and plant invasion

From 2018-2021 | Total budget € 250,000

## Cascading effects on seagrass ecosystem services

Ecosystems are currently altered by human-induced changes in large herbivores and invasive species abundances. Researchers investigated how green sea turtles, as large grazers, and invasive seagrass interactively affect seagrass ecosystem services.

Cascading effects of the presence of predators on green turtles and ecosystem resilience were monitored. The project helped to identify pathways for effective management of critical seagrass habitat through management of its herbivores and their predators.

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### More information

[penyu.nl](http://penyu.nl)

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# Ecology and protection of sea turtles

From 2019-2023 | Total budget € 500,000

## Caribbean cruisers in the Kingdom of the Netherlands: ecology and protection of sea turtles

What do we know about the icon of the Caribbean, the sea turtle?

Sea turtles in the Dutch Caribbean, the green and hawksbill sea turtles, are iconic animals. In accordance with international treaties, the Netherlands is obliged to ensure the protection of sea turtles. However, good nature conservancy policy must be supported by scientific knowledge about these animals.

This project retrieved many facts about the sea turtles by investigating their migration routes, population structures and use of their living environment. Periods of ocean cooling and warming exert a large influence on the size of sea turtle populations and their migration. The current global warming threatens the eggs in the nests, but some simple shading can reduce the nest temperature. After centuries of overhunting, populations in the western Caribbean seem to be recovering better than in the eastern part.

Researchers used satellite transmitters to map where the turtles nest, where they seek food and how they migrate between these locations. The green turtle is suffering from an encroaching exotic seagrass from the Red Sea, which it does not eat.

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### More information

[www.nwo.nl/en/](http://www.nwo.nl/en/)  
[what-do-we-know-about-icon-caribbean-sea-turtle](#)

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# Dry Forest Resilience and Restoration

From 2021-2023 | Total budget € 25,000

The Caribbean islands host one of the world's hotspots of biodiversity. Yet, extensive deforestation and overgrazing by feral livestock have resulted in loss of biodiversity, soil erosion and overflow of nutrients and sediments in coastal systems. Large scale restoration of terrestrial vegetation can reduce soil erosion improving the functioning of mangroves, seagrass fields and coral reefs that are essential for coastal protection to hurricanes and sea level rise. Restoring inland vegetation can also contribute to reduce the impact of future warmer climates on wildlife and people.

We aim to understand the resilience of dry forests and how to facilitate their restoration. We use field surveys and experiments to:

- assess the effects of herbivores including feral goats;
- monitor natural forest regeneration;
- assess active restoration projects;
- evaluate the ecological mechanisms that explain vegetation recovery
- evaluate the effects of ecological restoration on wildlife and inter-connected ecosystems

We team up with local organisations (e.g. ECHO, STINAPA) and colleagues from different disciplines and institutions to jointly understand the best ways to restore the natural richness of Bonaire.

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## More information

<https://www.wur.nl/en/project/Dry-Forest-Resilience-and-Restoration.htm>

## Contact

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# Bonaire 2050, a nature inclusive vision

From 2019-2022 | Total budget € 640,000

What would Bonaire look like in 2050? A future in which a sustainable economy and a nature inclusive society go hand in hand to maintain what is precious, and to restore what is damaged. Experts from the island and Wageningen University & Research addressed that question by working together with stakeholders on the island.

The very diverse landscapes of Bonaire range from dry cacti forests, traditional kunukus, biodiverse reefs, to extensive salt flats. For each of Bonaire's landscapes a vision with potential nature inclusive measures was mapped during design sessions, interviews and workshops with local experts, decision makers and researchers in the field of nature, culture, recreation, agriculture and governance.

The resulting drawings of each of the landscapes show measures such as rooftop water harvesting, reforestation, greening gardens, growing local food, creating cactus fences, installing solar panels, and coral restoration to meet the challenges ahead. These challenges include managing (mass-) tourism, preventing high erosion rates that are due to free-roaming cattle, and adaptation to sea level rise. The measures and challenges are symptomatic for many small tropical islands.

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## More information

[www.dcbd.nl/document/bonaire-2050-nature-inclusive-vision](http://www.dcbd.nl/document/bonaire-2050-nature-inclusive-vision)

## Contact

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# Living Lab Bonaire: an integrated approach for sustainability

From 2019-2022 | Total budget € 175,000

Bonaire has a unique environment and biodiversity; it has the richest biodiversity in the Netherlands.\* These unique characteristics make this small island an ideal showcase to develop a circular economy while respecting nature. At least 13 groups from WUR's different domains do research on Bonaire. In 2019, a Lab was inaugurated because of the cooperation between the Bioprocess Engineering Group (BPE/AFSG/WUR) and Water en Energie Bedrijf (WEB/Bonaire); a joint investment of 175K€. Together, these partners develop a project on sustainable microalgae production on the island (2017-2022). Our ambition is to turn this space into a living one; open to innovation and social engagement to solve complex socio-ecological problems, with multiple organisations as users: Living Lab Bonaire (LLB). In 2020, STINAPA (Bonaire's National Parks Foundation) became a member of LLB, bringing in more equipment and support materials.

Currently, we are equipped with basic lab facilities: fridges, freezers, milliQwater, spectrophotometer, photosynthesis measurements (aquapen), scales, oven and muffle, fume hood, water baths, tissue grinder and vortex systems, refractometer, light, temperature and pH meters, pipettes, filtration systems, ect.

\* Ecological values of the 12 miles zone of Bonaire Imares report C026/16 (2016)

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## More information

[www.algaeparc.com/projects/6/algaeparc-bonaire](http://www.algaeparc.com/projects/6/algaeparc-bonaire)

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## Traditional rice cultivation in Surinam

From 2021-2025 | Total budget € 682,753

Surinam Maroons are descendants of enslaved Africans who escaped from the plantations in the 17<sup>th</sup> and 18<sup>th</sup> century. Maroons grow hundreds of rice varieties that are hardly known to science but differ substantially from modern cultivars. Where does the Maroon rice come from? This project, financed by ENW-Klein II (NWO), combines ethnobotanical, historical and genomic research and links Maroon oral history to written sources from colonial archives and the DNA of their rice. Maroon rice fields probably reflect 370 years of migration and adaptation: ancient African landraces, historic US cultivars, rice exchanged with Asian contract laborers and self-developed varieties. This project contributes to the revaluation of a food crop with substantial importance for current and future food security and Afro-American cultural heritage.

This project, entitled *Hidden crop diversity in Surinam: tracing the origins of Maroon rice by integrating ethnobotany and genomics*, is carried out by Tinde van Andel (Naturalis, WUR) and Eric Schranz (Biosystematics, WUR), Harro Maat (Social Sciences, WUR), postdoc (genetics) Marieke van de Loosdrecht (WUR) and PhD student (ethnobotany) Nicholaas Pinas (Naturalis).

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**More information:**

[www.wur.nl/en/project/hidden-crop-diversity-in-Suriname-1.htm](http://www.wur.nl/en/project/hidden-crop-diversity-in-Suriname-1.htm)

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# Integration of SarSentry with the National Forest Monitoring System of Surinam

From 2020-2024 | Total budget € 400,000

Forests cover 93% of Surinam. To improve monitoring of the forest area, SarSentry methodology was demonstrated. Its capabilities to automatically detect and quantify forest degradation, even at light disturbance levels, are unprecedented. Other advantages are the near real-time (NRT) and fully automated production of disturbance maps (usually within two days after satellite overpass, covering the entire country, every 12 days) and the all-weather capability (because it is based on cloud-penetrating Sentinel-1 radar data).

The project will strengthen the National Forest Monitoring System (NFMS), specifically its NRT monitoring component. By integrating SarSentry within the NRTM, it can be used as a solid basis to enable the relevant authorities to react on possible encroachment immediately and to monitor compliance with licensed selective logging requirements.

The first phase of activities was conducted in the period 2020 until early 2022 within the larger framework of the WWF Forest Foresight programme, with a focus on demonstration. The second phase aims at technology transfer and capacity building and is scheduled for the period end of 2022 until 2024. The work is executed by Wageningen University and SarVision in collaboration with ISRIC, Foundation for Forest Management and Production Control (SBB), Ministry of Land Management and Forestry (GGB) and Anton de Kom University.

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# Climate Change Impact assessment in two regions of Surinam

From 2022 - December 2022 | Total budget € 75,000

One of the main threats of climate change on food systems are changes in the rainfall and temperature patterns often leading to an increase of the salinization in the soil and water. This is caused by sea level rise (SLR), increasing temperatures (more evapotranspiration) and changes in precipitation patterns. In this context, Surinam is developing a proposal to the Green Climate Fund (GCF) to improve the capacity of the Ministry of Agriculture of Surinam to build resilience to climate change in the agriculture sector. Under the overall objective of increasing the capacity of the Ministry of Agriculture of Surinam to prepare Climate Change projects, Wageningen Environmental Research (WEnR) will assist the Ministry in 2022 by preparing a climate change impact assessment study. The project will focus on the following three activities:

- 1 Perform a high-level, data-driven impact analysis of the vulnerability of crop yields in Surinam to flooding, drought and salinisation due to climate change, for 4 different crops (Rice, Banana, Cocos and mixed vegetables) and 2 regions (Nickerie, Coronie/Saramacca);
- 2 Development of a prototype database of agricultural and hydrometeorological data for the agricultural sector in Surinam, extracted from global databases as well as country-specific data based on locally available data;
- 3 Capacity building events for the staff of the Ministry of Agriculture and its implementing partners

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# SEALINK: Towards reef-friendly land development in the Caribbean

From 2021-2025 | Total budget € 3,500,000

Climate change, overfishing and excessive tourism, amongst other factors, negatively affect coral reef health. One often overlooked aspect is the effect of on-land processes on reef ecosystems. The interdisciplinary SEALINK project aims to quantify this effect and thereby reveal the link between land and sea.

An important aspect of this link is the flow of ground- and surface water, transporting sediments and solutes from land into coral reef ecosystems. So far, we have conducted a three-month field study on the semi-arid Caribbean island Curaçao to characterise the islands' hydrogeology. The field results will be combined with model simulations of ground- and surface water flows. These simulations will be used as input for more focused field measurements aiming to detect and quantify surface water flows and submarine groundwater discharge into the reefs.

The SEALINK project is hosted by CARMABI research institute on Curaçao and involves PhD students from NIOZ, TU Delft, VU Amsterdam, UVA Amsterdam, Utrecht University and Wageningen University & Research. Together, we aim to provide both fundamental insights as well as practical knowledge for reef-friendly land development.

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## More information

Caribbean | Sealink ([sealinkcaribbean.net](https://sealinkcaribbean.net))

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# Trends in the vegetation on Bonaire, St. Eustatius and Saba

From 2023-2024 | Total budget € 170,000

The “State of Nature” reporting on the Caribbean Netherlands (2017) showed a negative state and trend for many elements of nature on Bonaire, St. Eustatius and Saba. Evaluations of the state and trends were largely based on expert knowledge as limited data on terrestrial ecosystems are available.

This project foresees a data-driven trend analysis of the vegetation on the three islands. In the '90s, vegetation plots were laid out by de Freitas and others. The plots of de Freitas et al. will be revisited and the vegetation will be resurveyed. By comparing the new data with those from the '90s, changes in the vegetation will be quantified. Similarly, changes in the distribution and abundance of species will be analysed quantitatively. Trends will be related to changes in other factors such as change of land use (including grazing and urbanisation), climate change, spread of invasive species, impact of hurricanes, and natural succession. All vegetation types of the islands are included: pioneer vegetation and grasslands, scrub and thickets, deciduous, evergreen and elfin forests, mangroves, beaches, cliffs and steep rocky slopes.

The results will be used for the State of Nature reporting in 2024 and will be shared with local organisations. The project is carried out in close co-operation with Carmabi (Curaçao). Local partners on the islands are involved, including governments and national park agencies.

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**More information:**

<https://speciesdistribution.dcbd.nl/>

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# Turning the tide: restoration of marine biodiversity on Aruba

From 2023-2024 | Total budget € 713,348

The marine environment of Aruba is key to environmental resilience and the tourism economy but the marine park authority needs help to turn the tide of environmental degradation and biodiversity loss. Environmental deterioration puts pressure on the economic development of small island developing states (SIDS) and undermines environmental and economic resilience. A study (2018) concluded that the ongoing degradation of Aruba's marine environment will eventually not only suppress its small but valuable local fishery sector but also reduce tourist numbers and ultimately overall welfare by 50%.

This project, led by Wageningen Environmental Research will kick-start hands-on rehabilitation of Aruba's spatially linked coral reefs and mangroves. Monitoring results will provide key information for evidence-based policy making and management decisions, leading to a resilient marine environment of benefit to all. The enduring Aruban-Dutch partnership for nature will continue after project finalization, while project integration into the management of Parke Marino Aruba will guarantee continuity and lasting impacts. Wageningen Environmental Research is leading this project. Partners in the project are Fundación Park Nacional Aruba (FPNA), ScubbleBubbles Foundation, University of Aruba and Wageningen University (Marine Animal Ecology).



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## More information:

Turning the tide WUR

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## Endangered species of the Caribbean Netherlands

From 2017-2024 | Total budget € 250,000

The Caribbean Netherlands forms part of the so-called Caribbean biodiversity hotspot in which high biodiversity experiences high anthropogenic disturbance and ecological stress. High biodiversity expresses itself in an abundance of “range-restricted” species which are only found in a small area of the region and are often restricted to one or just a few islands. In turn, the high level of disturbance and ecological stress translate into a high level of endangerment of many species. Consequently, the Caribbean Netherlands are home to about 130 range-restricted or endemic species and more than 140 internationally endangered species. Very little is known about the local status of most of these. For science-based management, and protection of this high biodiversity much more needs to be known about most of these species.

Together with our island partners, in 2023 and 2024 our focus will be to assess the distribution, abundance and conservation status of:

- the rare and legally protected trees of Bonaire
- the rare and legally protected orchids of Saba and St. Eustatius
- the critically endangered and endemic iguana populations of Saba (*Iguana cf. melanoderma*) and St. Eustatius (*Iguana delicatissima*)

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# State of Nature in the Caribbean Netherlands

From 2017-2024 | Total budget € 320,000

The nation of the Netherlands carries ultimate responsibility for the implementation, execution and reporting of some seven international nature conservation treaties for the Caribbean Netherlands islands of Bonaire, Saba and St. Eustatius. These responsibilities translate into many obligations which bring with them numerous policy questions. In order to properly evaluate nature policy implementation and develop new nature policy plans, it is essential to monitor and regularly report on the “state of nature”. The first “state of nature” report for these islands was delivered in 2018. The methodology and criteria used conformed as closely as possible to those used in the European Habitat Directive.

A significant focus on applied biodiversity research is fairly new in the Caribbean Netherlands. Notwithstanding major recent investments in this type of work by the Ministry of Agriculture Nature and Food Quality, the knowledge needed for biodiversity management and conservation in the islands remains far behind what is minimally necessary. Even the most basic quantitative assessments and distribution maps for many species or species groups are often lacking.

Together with our island partners, in 2023 and 2024 our focus will be to:

- document the pelagic distribution of seabirds in the Caribbean Netherlands
- assess the status of the rarely-studied resident and breeding land birds of Bonaire, Saba and St. Eustatius
- map the distribution and abundance of rare and uncommon perennial shrubs and bushes of Bonaire

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# Sustainable Fisheries Development for the Caribbean Netherlands

From 2017-2024 | Total budget € 1,400,000

Compared to the European Netherlands, the agrarian sector of the small tropical islands of the Caribbean Netherlands, is limited by the lack of suitable land and freshwater sources. As a consequence, by comparison fisheries play a much greater role in island agrarian production and the economy than is the case in the European Netherlands. Hence, optimal use and sustainable management of fisheries resources is essential, not in the least because of their importance to the dive tourism sector of these islands. Traditionally the fisheries targeted nearshore, demersal, reef-associated multi-species commercial fish stocks, and most of these are either fully, or even over-exploited. Tropical fish stocks are typically data-poor and much research is needed to better monitor, guide and manage fishing activities so that fish stocks and catches can gradually recover.

On the otherhand, several pelagic fish stock have been much-less targeted by local fishing and likely represent considerable untapped fisheries potential. The main challenge is how to sustainably shift fishing effort more towards pelagic stocks to allow a sustainable increase in fisheries production while at the same time allowing sustainable recovery of the many over-exploited demersal and reef-associated fish stocks.

Based on expanded funding of this project in 2023 and 2024, together with our island partners our key goals for these two years will be to document and asses the pelagic fish stock potential for these islands and determine sustainable fishing limits for the lobster, snapper and grouper stocks of the Saba Bank.

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# The fish nursery function of mangroves in Bonaire

From 2022-2023 | Total budget € 40,000

Mangroves are unique trees adapted to life in saltwater. They fulfill many important environmental and ecological functions along tropical coastlines around the world. These include functions in coastal protection, land-building in deltaic settings, adaptation to sea level rise, the sequestration of nutrients and contaminants from land and the sequestration of carbon from the atmosphere. They are among the biologically most productive ecosystems known, serve as habitat to many birds and crustaceans and also play a key role as nursery habitat for juvenile marine coastal fish.

In recent years the WUR has done many studies on mangrove ecology and restoration in different parts of the world, including the Caribbean Netherlands. In this project, we used trap-cameras, dataloggers and classical transect surveys to assess fish densities in different mangrove habitats of Lac Bay in Bonaire. The results showed that the main body of the mangrove forest had very little value as actual habitat for most species of fish. Most fish principally occurred in the channels and creeks that traverse the mangrove forest. Therefore, the results predict that mangroves with more channels and creeks will be more productive as fish nursery habitat and suggest that maintaining such channels and creeks will be key to the mangrove forest's role as fish nursery habitat.

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The mission of Wageningen University & Research is "To explore the potential of nature to improve the quality of life". Under the banner Wageningen University & Research, Wageningen University and the specialised research institutes of the Wageningen Research Foundation have joined forces in contributing to finding solutions to important questions in the domain of healthy food and living environment. With its roughly 30 branches, 7,200 employees (6,400 fte) and 13,200 students and over 150,000 participants to WUR's Life Long Learning, Wageningen University & Research is one of the leading organisations in its domain. The unique Wageningen approach lies in its integrated approach to issues and the collaboration between different disciplines.

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**More information**

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## Colophon

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