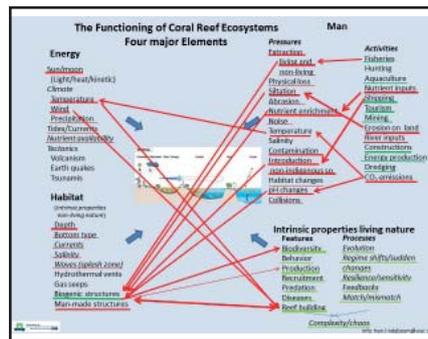
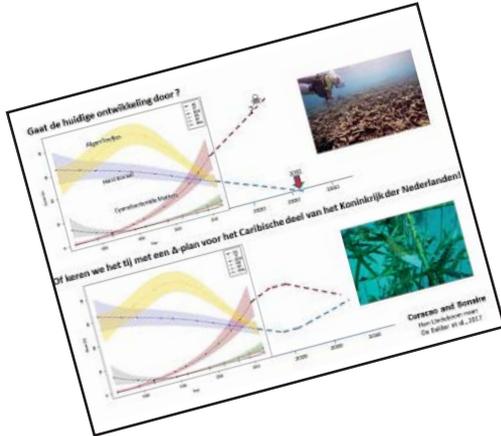


# Draft $\Delta$ -Plan for preserving the coral reefs, water quality, economies and safety of the Caribbean part of the Kingdom of the Netherlands and improving relations

Professor Han J. Lindeboom





## Summary

**The coral reefs surrounding the six Caribbean islands of the Kingdom of the Netherlands are in danger of disappearing within the next 15 years. This would cause a large part of the islands' economies to collapse. A new delta plan is needed to turn the tide.**

This document describes the background, objectives, structure, funding needs and political implications of a  $\Delta$ -Plan ('delta plan'; see footnote 1 on page 5 for an explanation of the name). Subjects that are relevant to all the islands and suggested projects for individual islands are covered in chapters 5 and 6, respectively.

Important causes for the disappearance of the coral reefs are excessive inputs of nutrients from land (eutrophication), erosion, overfishing, wrong forms of coastal development, pollution, invasive species and climate change. For the programme to be effective it must drastically curb eutrophication of the sea, prevent land and coastal erosion, minimise the negative effects of dredging and sand nourishment, facilitate climate action in the Caribbean, significantly improve waste processing and restore fish populations.

The  $\Delta$ -Plan could do much more than save the reefs. In the long term, it should also save the islands' economies, reduce poverty, offer our Caribbean compatriots the same level of safety that we have in Europe and serve as a basis for improving relations within the Kingdom.

In talks, representatives of all the islands have indicated their willingness to participate in the  $\Delta$ -Plan. They all understand that it is absolutely crucial to act *now*.

The new Council of Ministers of the Kingdom will be asked to set up a task force to further identify the major problems, and propose and implement solutions. To finance the  $\Delta$ -plan for the coming 10 years, a structural budget of € 50-100 million per year is needed.

*Nos no por bay bek den pasado, solamente nos por crea condicionan primordial pa e futuro. Ta sigur cu nos no lo haya tur coral bek, pero si nos por proteha y rende mas hopi posibel di locual nos tin. Nos ta hasie pa esnan cu ta bin después di nos.*

We can't return to the past, just create boundary conditions for the future. We certainly won't get all the coral back, but we can do our best to protect and expand what we still have. We do this for all future generations.

*We kunnen niet terug naar het verleden, alleen randvoorwaarden scheppen voor de toekomst. We krijgen zeker niet alle koralen terug, maar kunnen wel wat we nog hebben zoveel mogelijk beschermen en uitbreiden. We doen het voor allen die na ons komen.*

(Han Lindeboom, Texel, 5 April 2017)

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## 1. Background: Why is a $\Delta$ -Plan (Delta plan)<sup>1</sup> necessary?

On 6 December a symposium called ‘The Ecological and Socioeconomic Future of the Coral Reefs of the Caribbean’ was held at the Royal Palace Amsterdam. During that symposium Professor Jeremy Jackson gave a lecture entitled ‘Can we save Caribbean coral reefs and, if so, how?’

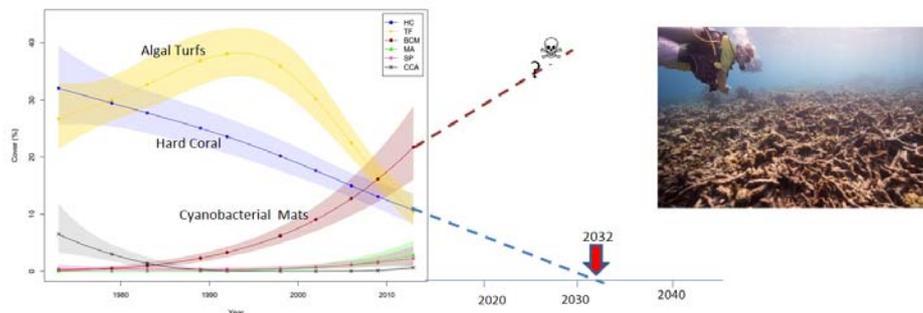
From Prof. Jackson’s lecture it became apparent that the coral reefs are in very poor shape. They are severely affected by overfishing, irresponsible coastal development, pollution, eutrophication, erosion, invasive species and climate change. Relative to other Caribbean islands, the coral reefs around the islands of the Kingdom of the Netherlands are not in the worst condition. However, if action is not taken soon, many of these coral reefs will disappear in the coming decades. In his lecture, Prof. Jackson said there was hope but only if we act now.

*‘It’s not hopeless if we get serious.’*

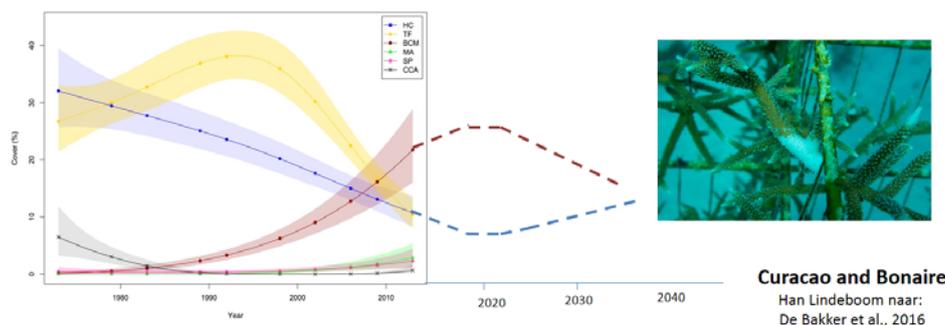
- Designating one-third of coastline as strict no-take and no-use zones
- Environmental impact assessments for all development, with burden of proof on the developer
- All development set back hundreds of metres from the coast
- Zero sewage discharge and run-off from land
- Limits on size and number of cruise ships
- Strict enforcement with severe penalties

*‘Otherwise the reefs will be dead.’*

### Will the trend continue ?



### Or will we turn the tide with a $\Delta$ -plan for the Caribbean part of the Kingdom of the Netherlands!



<sup>1</sup> The name ‘Delta Plan’ was chosen to emphasise the urgency and scale of the problems. The islands requested that the notation be changed to  **$\Delta$ -Plan**, not only to distinguish it from the Delta Plan in the Netherlands, but also because the Greek letter  $\Delta$  stands for change. Change is desperately needed, not least in the way the European and Caribbean parts of the Kingdom interact.

In a talk entitled ‘Hidden treasures: corals offer man lessons about symbiosis from the invisible underwater world’, Dr Glenn Thodé said that the coral reefs are of crucial importance to the Caribbean islands. As an important tourist attraction, they are the mainstay of the islands’ economies. In a number of locations, the reefs help to protect coastal areas. They are also a significant source of food. Without a change in current policy, these benefits will all disappear and the islands will suffer severe economic damage. To prevent this from happening, a comprehensive approach to the problem is needed. A great deal is already being done in the region and government agencies and NGOs are already implementing management plans and recovery projects. But because these activities are so fragmented, the ultimate objectives of preserving and restoring the coral reefs are not being achieved.

This prompted the call for a  $\Delta$ -Plan to save the coral reefs.

## **2. Objectives of the $\Delta$ -Plan**

After consultations with the Ministries of the Interior & Kingdom Relations, Economic Affairs, Infrastructure & the Environment, and Education, Culture & Science, Professor Han J. Lindeboom visited each of the six Caribbean islands from 20 February to 6 March 2017 and met with representatives of the governments, national parks and other stakeholders to discuss their views on the  $\Delta$ -Plan and their willingness to participate. All of the islands indicated that they are keen to take part and acknowledged the need to act quickly. Each of the three constituent countries – Aruba, Curaçao and St Maarten – and the three public bodies – Bonaire, Saba and St Eustatius – have unique problems that require tailor-made solutions. In setting up this programme, the following considerations will play a role:

1. The  $\Delta$ -Plan can boost the development of nature and environment policy in the Caribbean part of the Kingdom that will better protect the coral reefs and related ecosystems in the long term. For example, nitrogen and phosphorus enrichment, caused by inadequate sewage treatment facilities, is one of the greatest threats to corals. This needs to be remedied on all the islands so that nutrient enrichment of the marine environment is stopped or reduced to negligible levels. Improving the removal of intestinal bacteria from sewage effluent will also benefit public health.
2. The  $\Delta$ -Plan must be compatible with a sustainable economic policy. If the Netherlands is going to invest substantial funds in the  $\Delta$ -Plan while the islands are struggling with poverty, it is vital to establish a connection between protecting the reefs and developing the economy. People – local residents and visitors – must be the central focus of this programme. For example, Bonaire’s economy is largely dependent on tourism, and diving and snorkelling are the main attractions. Protecting the island’s marine and land-based ecosystems is a condition for developing the tourism industry further. On the other islands, too, enormous economic problems will ensue if the reefs disappear for good. Other measures to save the coral, such as tackling erosion caused by overgrazing and restoring populations of larger fish species, can create new economic opportunities. Activating local food production can also help achieve these goals.
3. The  $\Delta$ -Plan must be compatible with ideas on and development of policy that anticipates the effects of climate change in the Caribbean part of the Kingdom. The expected rise in sea level and water temperature will have a major impact on the coral

and the islands. Policy that anticipates and responds to this, much like water security policy in the Netherlands, is necessary. In the Netherlands, one to two billion euros is spent on the Delta Programme each year. An amount equal to 4% to 8% of that budget could save the six Caribbean islands.

To prepare for the effects of climate change it is important to protect the islands' coastlines. Nature development (e.g. planting mangroves and seagrass beds, creating artificial reefs, and 'building with nature') can provide extra protection for coasts and reefs.

4. The  $\Delta$ -Plan must not be a purely European affair. The governing bodies, national parks and nature conservation NGOs in the Caribbean part of the Kingdom should be owners or co-owners of the programme and be closely involved in its development and implementation. During my consultations with government representatives, each of the islands indicated its awareness of this and willingness to participate. This will result in a programme that is tailored to the needs of each island. Informing and educating island residents and visitors is an important condition for the  $\Delta$ -Plan's success.
5. Research will be a constant necessity for developing and implementing the  $\Delta$ -Plan. It should be conducted in cooperation with organisations on the islands wherever possible.

The Delta Plan established after the North Sea flood of 1953 focused on water management in the southwestern region of the Netherlands and fostered technological research and development. The Netherlands became a world leader in water management technology.

The  $\Delta$ -Plan aimed at protecting the coral reefs and coastlines of the Caribbean islands has the same potential to foster research and technological advancements that could be used to protect reefs and coastal areas around the world. This kind of development could give a significant boost to the islands in the area of technology. Alignment with the Blue Route and Circular Economy of the National Research Agenda will have added value.

6. The pessimistic view is that implementing a  $\Delta$ -Plan for the coral reefs is a fruitless exercise given the rising sea temperatures. However, combating other stress factors will enable the coral to cope better with climatic influences. Protecting this unique ecosystem that harbours so much biodiversity and offers such enormous economic value is and should always remain a government responsibility. The Kingdom also has obligations under international agreements such as the SPAW Protocol, the Bonn Convention, the Convention on Biological Diversity and the Inter-American Sea Turtle Convention. The European part of the Netherlands has a formal, ethical and historical responsibility to ensure that this unique system is protected and the safety of the islands and their populations guaranteed. In this way, the Netherlands can also demonstrate its concern for this unique ecosystem that deserves protection and its engagement with the people of the Caribbean part of the Kingdom.

### 3. Task force and funding required

Parliament and the parties in the new governing coalition in the Netherlands are urged to include the development and implementation of the  $\Delta$ -Plan in the government's statement of policy upon taking office. They are also urged to establish a task force and set aside the funds required to implement the programme.

The task force should be comprised of representatives of all the islands and include, for example, representatives of each island's government and national park organisation, as custodians of the natural environment, plus representatives of the relevant ministries in the Netherlands and a number of experts on coral reefs and socioeconomic development in the region. A programme geared towards tackling local problems and priorities should be drawn up for each island. It would make sense to set up a local task force for each island as well, which can draw up and comprehensively implement these local programmes.

The cost will depend on the level of ambition, but the funding requirement will be substantial. The amounts proposed below are rough estimates over a 10-year period and would have to be divided over the six islands. The budget items are as follows:

- effective wastewater treatment for all the islands that removes nitrogen and phosphorus (EUR 300 million)
- effective waste management, preferably in connection with a waste-to-energy system; a combined approach for St Eustatius, Saba and St Maarten (the SSS islands) may be possible (EUR 250 million)
- restoring drainage basins on the islands, preventing excessive erosion, preventing major damage and casualties due to flooding, and retention of rainwater for use as potable water and for irrigating agricultural areas to be developed (EUR 150 million)
- combating coastal erosion by restoring old dams and constructing new dams in rivers flowing into the sea and tailor-made local measures; this includes conservation of seagrass beds and beach vegetation (EUR 150 million)
- comprehensive spatial planning in coastal zones; no construction within hundreds of metres of the coastline; further protection and expansion of existing and new national parks (EUR 100 million)
- a fisheries programme entitled 'Bring back the big fish' (EUR 50 million)
- thorough and accurate environmental impact assessments of all developments (unknown)
- better regulation of cruise ships; number, environmental pressure and revenues (unknown)
- reducing free-grazing (by goats, donkeys and cattle) to combat coastal and inland erosion (EUR 12 million)
- combating invasive species (including lionfish and various plant species) (EUR 6 million)
- education, capacity development, accompanying research and awareness (EUR 80 million)
- strengthening national parks management bodies (EUR 30 million)
- strengthening the coast guard and using drones (unknown)
- strict enforcement and effective punishment of violations (unknown).

To finance the  $\Delta$ -plan for the coming 10 years, a structural budget of € 50-100 million per year is needed.

By comparison, the Netherlands in Europe will spend a total of EUR 20 billion on water security, climate change adaptation and the environment over the next decade. Annual spending for the first four years of the  $\Delta$ -Plan will be: EUR 15 million in year one (start-up phase, including setting up a Task Force Office), EUR 75 million in year two, EUR 100 million in year three and EUR 150 million in year four. A large portion of budget will be spent on infrastructure; interest-free loans, new grant funds and cofinancing arrangements could lead to significantly lower costs.

#### **4. The $\Delta$ -Plan: political implications**

Many of the people I spoke to indicated that there are major problems at both political and executive level between the Netherlands in Europe (EN) and the Caribbean part of the Kingdom (CN). I will provide an overview of the issues in this section.

Nearly all of the discussion partners brought up the cultural differences between EN and CN. The dominant Christian culture in EN has evolved over many centuries; while in CN, where the current form of government was only recently established, the culture is a melting pot of traditions and influences from indigenous peoples and immigrants who came to the islands either voluntarily or by force. The impact of the slave trade is still palpable today.

The current constitutional structure of the Caribbean part of the Kingdom – three constituent countries and three public bodies – took effect on 10 October 2010 (10/10/10). Aruba, which has been autonomous since 1986, served as an example for its sister islands. There are now two different forms of government in the Caribbean part of the Kingdom. As a result, the public bodies of Bonaire, St Eustatius and Saba (BES) and the countries of Curaçao, Aruba and St Maarten (CAS) have a different status vis-à-vis the European part of the Netherlands. The countries are autonomous and associated with the Kingdom through the Ministry of the Interior and Kingdom Relations and the Ministry of Foreign Affairs, while the public bodies are part of the Netherlands and fall under the responsibility of all the ministries of the Netherlands.

Under the new constitutional structure, promises and agreements were made which, according to my discussion partners, have not been kept, have been watered down or have not produced any results. It is worth noting, though, that all of the partners in CN were reasonably to highly satisfied about EN's efforts to make structural improvements to healthcare and education. They emphasised that a number of things are going well, but there are also many problems.<sup>2</sup>

One of my discussion partners explained that there is one issue that overshadows all others in relations between EN and CN, which is directly related to the difference in culture and expectations mentioned above. All kinds of issues are discussed but everyone always tiptoes around the elephant in the room. In order to continue working together within the Kingdom, all parties must openly discuss and acknowledge the problems, cultural differences and diverging visions of the future, and then find solutions. Almost everyone said they were pleased that someone had come to ask them what they want instead of telling them what to do. Perhaps that should happen more often. I asked each of them to sketch a picture of their

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<sup>2</sup> See also: Oostindië, G. (2016), 'Politieke zonden in het trans-Atlantische Koninkrijk', in: *Zonden in de politiek: jaarboek parlementaire geschiedenis 2016*, Amsterdam: Boom Uitgevers, pp. 59-69.

vision for their island 5, 10 and 25 years from now, and they all expressed the need to focus on people and the desire for a prosperous and happy island community.

All six island governments have indicated that they are eager to participate in the  $\Delta$ -Plan and take on co-ownership of the plan. However, they also expressed the hope or expectation that, in addition to saving the coral reefs, action would be taken to reduce poverty and improve their local economies.

I saw many examples and have a number of ideas about how these objectives could be achieved. Now it is imperative for both sides to foster the desire to take action so that real changes are made possible. As one of my discussion partners said, 'Educating the mind without educating the heart is no education at all.' And that goes for policy and management too: they must have both a rational and an emotional basis.

The formal relationships between EN and the public bodies (the BES islands) and between EN and the other constituent countries of the Kingdom (the CAS islands) are described separately below.

#### **4.1. Public bodies: Bonaire, St Eustatius and Saba**

The constitutional status of the BES islands is laid down in the Public Bodies (Bonaire, St Eustatius and Saba) Act. In contrast to EN these islands have no provincial tier of government and must therefore conduct all their business directly with the ministries. This has both advantages and disadvantages. Matters that are managed by the provincial authorities in EN are not always dealt with sufficiently for BES. I asked whether they too would like to have a provincial tier, but they preferred not to add another layer of government: 'that would mean even more civil servants to deal with and we see enough of them as it is'.

There is a great deal of resentment about the way civil servants from the Netherlands interact with the island communities. There are some civil servants who stay for more than a year and try to absorb as much of the language and culture as they can. This is generally appreciated on the islands. These individuals gain an understanding of the island, adapt their pace somewhat and, if there is a personal click, can serve as a bridge to local authorities. But that can only happen if their organisation in EN gives them sufficient latitude, and that is not always the case.

There are also those I call 'fly-in civil servants', who swoop in on a flying visit to explain what needs to be done or what cannot be done and then leave again. They come back a year later to do the same or, if they have moved on to another job, someone else comes to tell the islanders what's what. This is not terribly productive. Moreover, it turns out that individual civil servants or ministries regularly disagree with one another, have overlapping tasks, give contradictory signals, thwart solutions and get caught up in rules and regulations that were made for EN and do not work in CN. As a consequence, much less is achieved than could be. This applies to a diverse range of issues and certainly to nature conservation.

There is criticism of the way the Netherlands uses its financial and human resources in the region. While the islands receive a significant amount of money, too much of it is swallowed up by bureaucracy, short-term projects and inadequate regulations. The BES islands want greater autonomy, within limits and taking account of the potential for corruption, which is recognised as a problem. There is a strong sense that much more could be achieved – probably also for the  $\Delta$ -Plan – with the resources currently available.

The problems with public transport between the islands is another issue that was frequently raised. Public transport in EN is well organised. In CN residents have to pay USD 200 to get from one island to another, and I personally experienced how unreliable the air connections currently are. With better transport between the islands, island-hopping would be much more common among residents and tourists alike. If it is done right, the service could even become self-supporting, like on the island of Texel in EN. The Caribbean islands – like Texel in the past – just need a boost.

In addition to smaller local projects, the  $\Delta$ -Plan also includes a number of large-scale projects: construction and improvement of wastewater treatment plants, restoration of drainage basins, anti-erosion measures and climate adaptation, including coastal defences. All this is in place in EN and it is high time it was developed in CN as well. A comprehensive approach that is independent from individual ministries is necessary to achieve this.

I would therefore recommend the  $\Delta$ -Plan be designed like the new Delta Plan in the Netherlands ('Delta Programme'), with a  $\Delta$ -Commissioner who has capacity to act within the boundaries of an agreed mandate and can prevent the programme from getting bogged down in excessive bureaucracy and misunderstandings.

#### **4.2. Countries: Curaçao, Aruba and St Maarten**

One of the discussion partners made the following observation: 'It is nice to have an umbrella for the shade, but the rain cannot trickle through it.' What she meant was that Curaçao, Aruba and St Maarten are happy to be part of the Kingdom but this status also has negative consequences for them. It is much more difficult for them to obtain certain subsidies from international organisations to which other independent island states have access. They are also unable to obtain recognition as SIDS (Small Island Developing States). I was told that France manages to acquire much more in EU subsidies for its islands than EN. The CAS islands would like to see more 'rain under the umbrella', i.e. more EU funds.

By chance, I met someone at the airport on one of the CAS islands who told me that he had been fired from his job as a senior civil servant because he had been critical of the policy on environmental laws and their enforcement. According to him, there is a culture of fear and no protections for whistleblowers. Those in control keep a firm grip on their power and even when agencies are sufficiently staffed they lack the authority needed to carry out their tasks properly.

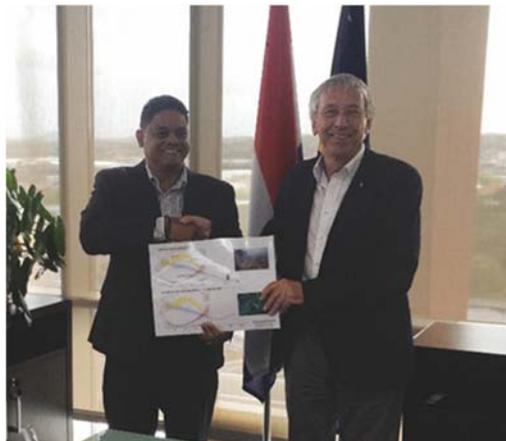
I was also told that there is animosity among civil servants working for different ministries in the Netherlands. This can lead to the same kind of deadlock that is sometimes experienced in the public bodies.

Furthermore, the constituent countries face the same problems in the areas of nature conservation, poverty and economic development as the public bodies. The difference is that they are responsible for solving these problems themselves. The Kingdom could offer a helping hand, not least because both forms of government are present in the two groups of geographically adjacent islands (i.e. the *Windward islands* (Saba, St Eustatius and St Maarten) and *Leeward islands* (Aruba, Bonaire and Curaçao) islands). A solution for the waste and energy problems on St Maarten could also serve St Eustatius and Saba. Bonaire and Saba have the potential to become the most beautiful islands in the Caribbean. In fact, in 2016 both islands entered the competition for 'most beautiful natural area in the Netherlands'. (Unfortunately, they are relatively unknown in the Netherlands, so Bonaire did not even make

the short list and Saba came in last.) Curaçao and St Maarten also stand to benefit from an increase in nature-oriented tourism on Saba and Bonaire because they, too, have unique characteristics that would appeal to a lot of visitors. The key is for the islands to work in concert, establish and advertise a strong brand and offer such a quality experience that if you haven't been to these islands, you haven't been to the Caribbean.

#### 4.3. Conclusion

In all of the discussions the general opinion was that a  $\Delta$ -Plan for the Caribbean part of the Kingdom is a good idea. It is essential to save the coral reefs and the economy, and it must happen quickly. Along various coasts the input of nutrients in coastal waters is so abundant that eutrophication is becoming a problem, and the white sandy beaches could soon be affected by slimy and possibly toxic algal blooms. This could destroy the tourist industry and bring economic disaster. If and when Cuba opens up and develops, American tourists will opt for its casinos and mass attractions. The islands of the Caribbean part of the Kingdom are economically dependent on tourism. In order to secure the health of the tourist industry for the long term and for future generations, each island must be able to offer a unique product with world-class appeal. Each island has the potential and necessary ingredients to do that: natural beauty on land and underwater, history, culture, tranquillity, relaxation, sunshine and beaches.



The response was enthusiastic on all the islands. Governor Jonathan Johnson on Saba and Minister of Economic Development Eugene Rhuggenaath on Curaçao are shown here.

The  $\Delta$ -Plan can do much more than rescue the coral reefs. In the long term, it should also save the economies of the islands, reduce poverty and form a basis for improving relations within the Kingdom. Appointing a Kingdom Commissioner to advance the latter objective is an option, and has been done in the past.

In order to achieve real results, everyone must be prepared to go the extra mile. The time is ripe.

## 5. General issues for all islands

All of the islands need better wastewater treatment plants that include nitrogen and phosphorus removal systems. As many households and businesses as possible (including all hotels and other tourist accommodation) should be connected. Effluent containing nitrogen (N) and, in particular, phosphorus (P) devastates coral reefs, feeding algal blooms in general and ultimately giving rise to potentially toxic cyanobacterial blooms.

Waste disposal on all the islands is inadequate. It is essential to close all open and leaking landfill sites and introduce adequate facilities for waste processing. For each of the islands, measures should be tailored to the local situation (see the next section).

Erosion is an enormous problem and also presents a threat to human safety. Silt deposits kill corals. Adaptation to climate change should be part of any plans for dealing with erosion. Constructing water basins to prevent excessive run-off and to harvest rainwater for use as inexpensive potable water and for irrigation on the islands would create win-win situations. For this part of the programme, it is important to ensure island-specific measures are taken to combat disease and mosquitos.

When developing island-specific measures, potential returns and feasibility will need to be assessed.

- Ecological return: are we protecting all the reefs that are worth protecting or are we protecting all the reefs we still have?
- Economic return: in each area are we taking the measures that produce the greatest return on investment?
- Social return: is there sufficient public support for the measures, and can we get the local population enthusiastic about implementing them?
- Institutional feasibility: do local organisations have the capacity to implement the proposed measures in the long term and, if not, where is additional capacity needed?

### **Nature conservation and national parks**

Coral reef protection should be part of the islands' broader conservation policy. All of the islands have designated national parks that are managed by private organisations (NGOs) (see map overleaf).

The national parks have jointly formed the Dutch Caribbean Nature Alliance (DCNA). The marine parks play a crucial role in protecting the coral reefs. The national parks in the Caribbean work differently than those in the European part of the Netherlands. In EN, the national parks are managed by public-private partnerships which are funded in part from the public purse. They mainly focus on active conservation measures (for example, grazing) to maintain areas and landscapes shaped by human activity. CN still has pristine nature areas, especially marine areas, that must be protected. The core tasks are to establish and enforce protective measures. In the Caribbean, private organisations carry out these conservation and management activities, and raise a large part of their funding themselves. On islands like Bonaire, where recreational divers pay a compulsory user fee, private revenues are more easily obtained than on other islands. Enhancing park funding is a precondition for the implementation of the  $\Delta$ -Plan.



The islands and their national park bodies

In EN, central government has delegated nature management to the provincial authorities. In the Caribbean, this task is insufficiently organised, in part because there is no provincial tier of government for the BES islands. The private organisations that manage the national parks have insufficient capacity for enforcement, education and research on top of their nature conservation tasks. If I draw a parallel with the Dutch situation, in addition to the necessary additional investment in material (ships and offices), each park would need an extra contribution from central government of EUR 150,000 to EUR 250,000 to be able to employ sufficient staff, not just for enforcement, but also for project management and implementation (organisation, research and environmental impact assessments). Financing could be provided directly or through the existing DCNA trust fund, which disburses funds to the parks on an annual basis.

### **Protecting mangroves and seagrass beds and combating introduced species**

Environmental conservation involves more than protecting the coral reefs. The main features of the marine environment of the six islands also include mangrove forests and seagrass beds. These natural resources are very important to local fisheries, tourism and coastal protection. The current size and quality of the seagrass beds, mangroves and coral reefs are cause for concern. Where possible, ecosystem restoration measures must be taken to ensure that these habitat types are still able to deliver vital ecosystem services to humankind in the future.

A number of habitat restoration initiatives have already been launched, but they need to be expanded to have any real effect. Examples include the reef restoration projects on Curaçao, Bonaire, Saba, St Maarten and St Eustatius and the mangrove restoration projects in Piscadera Bay on Curaçao and in Lac Bay on Bonaire.

Endangered deep-sea and migratory marine species, such as sea turtles, sharks and rays, and land species, such as iguanas, need protection too. A lot is being done already. Coordination between species conservation efforts and the  $\Delta$ -Plan is necessary for spatial planning policy that is optimally geared to conservation goals.

The issue of invasive species also requires attention. The lionfish, a non-native invasive species, is decimating local fish populations and should be eradicated. Lionfish are already

being actively hunted, eaten as a delicacy and served up at local BBQs. On Saba local fishers are willing to take measures to curb overfishing of indigenous species while selectively catching lionfish. This should be encouraged and financially supported on all the islands. On land, too, there are a number of invasive plant and animal species that are causing significant damage locally, for which additional management plans need to be developed and carried out.

### **Agriculture, livestock farming and fisheries**

There is little agriculture on the islands and livestock are generally allowed to range freely, causing major environmental deterioration and erosion. On Bonaire a pilot project was launched four years ago to keep goats in enclosures. Unfortunately, it is at risk of being terminated. Attempts are also being made to solve the problem of free-grazing livestock on Saba (goats) and St Eustatius (donkeys, cattle and goats). Additional funding is needed to tackle this problem, but it also presents an opportunity. Measures such as cultivating pastureland should be taken to ensure that all livestock are kept in enclosures and animal feed is affordable. A breeding programme could be launched to improve the goat herd and develop a high-quality local product that yields the best meat. Goat meat from Bonaire or St Eustatius could one day have a reputation comparable to that of lamb from Texel; the best there is. There are people who can do this. What is needed is sufficient, longer-term start-up funding.

Agriculture on the islands also needs a boost. There is enough land, but it has been neglected and circumstances are not ideal. If water retention areas are built or clean water from the treatment plants is made available, there will be water for irrigation. For the time being, the climate is favourable; breeding programmes to improve and further adapt plants and animals to local conditions are advisable. Wageningen University and Research Centre can play an important role in developing agriculture and livestock farming. If done properly, it could create significant employment and reduce poverty.

Fish stocks have been decimated by overfishing; the large fish that were once plentiful are disappearing. As a local fisher told me, ‘My father’s catches were very different from mine.’



Catch of the day in 1956



and in 2007

The reduction in stocks of large fish and species that help keep the coral reefs healthy, including grazing fish such as the parrotfish, has dramatically affected the reefs. Without these grazers, the coral is being overrun by algae.

To restore fish populations, Jeremy Jackson recommends banning commercial fishing in one-third of coastal areas. Various islands have indicated that this is politically difficult to achieve. Following consultations with island government representatives and a number of fishers, there is now a proposal to develop and implement a ‘Bring back the big fish’ programme. The programme could include the following components: developing and applying more selective fishing techniques; limiting catches to medium-sized fish; creating artificial reefs; protecting

fish breeding grounds; tightening fishing regulations; creating temporary or permanent ‘no-take’ zones, actively stimulating fish growth; and carrying out enforcement.

### **Tourism**

Tourism is the cork that keeps the Caribbean islands afloat. Some 60 to 80 per cent of revenues are generated by tourism. Loss of this source of income could devastate the economies of the islands. In addition to saving the coral reefs, all the aforementioned environmental measures are needed to maintain and, where possible, expand tourism as an economic activity.

Transport connections between the islands are an obstacle to further development, as set out in section 3. It is advisable to explore further how good ferry connections could be established and operated among and between the two island groups (ABC and SSS). Current developments in both island groups should be given all the support they need.

However, there is a downside to the growth in tourism. A significant number of tourists come to islands by cruise ship, and not all of the islands are equipped to deal with large influxes of people for very short visits. Furthermore, this form of tourism generates relatively little income for governments and local populations. In the context of sustainable economic development, this deserves further attention.

Not all tourism is good, and that is true for both land-based and water-based tourism. Excessive numbers of tourists can damage and disturb the natural environment and diminish its amenity value. An ecological and economically sustainable approach to tourism could be part of the  $\Delta$ -Plan.

### **Combating poverty**

Various island governments indicated that, as co-owners of the  $\Delta$ -Plan, they believe poverty reduction should be part of the plan. In addition to education and capacity building, creating work and jobs for locals could be an important component. All the islands have capacities; it is important to use them in a positive way that generates employment. I heard an interesting example of mounted lionfish being sold as attractive and original souvenirs. And although this is a sensitive issue, initiating new forms of agriculture, livestock farming and fishing (for flying fish, for example) could also contribute to employment. If the  $\Delta$ -Plan is launched as intended, i.e. with a number of large-scale infrastructure projects on each island, their contribution to reducing poverty among the local population should be considered from the start. Bonaire, Saba and St Eustatius stressed that they would like the Ministry of Social Affairs and Employment to be involved in this aspect of the  $\Delta$ -Plan.

### **Education, capacity building and communication**

The future of the Caribbean coral reefs depends on effectively educating the users and protectors of the future, our children and grandchildren. Good education is a primary requirement if we wish to make the natural environment a permanent fixture in our culture. In recent years education on the islands has been a priority issue and it is becoming better and better. However, as one of my discussion partners said, ‘Educating the mind without educating the heart is no education at all.’ In consultation with local authorities, schools and the national parks, the curriculum on the natural environment could be expanded and made more appealing. It is also important to teach children to swim and foster a love of the sea, and there are various ranger programmes that could be expanded and supported. The Waitt Institute is very active on Curaçao with its Blue Halo Initiative. It would be interesting to find

out whether it dovetails with the  $\Delta$ -Plan and whether similar initiatives could be conducted on the other islands. The Caribbean Sustainable Development Forum (CSDF), which held a very interesting large-scale conference on Aruba while I was there, can play an important role in the further development of projects. I spoke with many people who have very good ideas about this and I hope to involve them directly in the  $\Delta$ -Plan.

In this regard, it is important to build capacity and provide targeted education based on the needs of the future. Brain drain from the islands to Europe and the US is a problem, so it is advisable to determine what can be done to make the islands more attractive to returning islanders. Communication about the  $\Delta$ -Plan as a whole and about local initiatives is crucial to the plan's success and should be given priority. If the  $\Delta$ -Plan is launched and a task force is established, support staff will be needed, primarily for communication. This could be done by a small team and an office similar to the office of the Delta Programme Commissioner in the Netherlands.

### **Research**

There will be an ongoing need for research as the  $\Delta$ -Plan is developed and implemented, because we need to know what works and what does not. Whenever possible, research should be conducted in cooperation with organisations on the islands. As eutrophication is one of the primary threats to the reefs, it is crucial to measure inputs of nitrogen and phosphate compounds accurately on all the islands. The Caribbean Netherlands Science Institute on St Eustatius has suitable equipment for this purpose and, if there are enough analysts, can do this for the SSS islands.

Research into the socioeconomic, sociocultural and enforcement elements of the  $\Delta$ -Plan (for example by the Institute for Environmental Studies and the Netherlands Institute for the Study of Crime and Law Enforcement of the Vrije Universiteit Amsterdam) could provide a solid scientific basis for the  $\Delta$ -Plan. With a view to better integrating nature protection and economic development, it would be worthwhile exploring whether a UNESCO Man and Biosphere approach would be a good way to frame the process.

There are also questions concerning the impact of Venezuela and of major South American rivers like the Orinoco and the Amazon on water quality in the Caribbean. Further research is desirable.

To facilitate measures to conserve the coral reefs and their surroundings (including sinking wrecks for tourism and building artificial reefs to attract fish), accurate bathymetric and seabed classification data are needed. The Hydrographic Service of the Royal Netherlands Navy has a mobile multibeam system capable of mapping the seabed around all the islands in a matter of months. In addition, other research institutes could use the multibeam data to make a classification of the seabed. It is a good idea to save the collected bathymetric data for a longer period than is currently the case so that developments over time can be monitored and studied.

The  $\Delta$ -Plan could stimulate technology development and research on coral reef and coastal conservation that could be applied around the world. This could give the islands a significant boost, especially as a technological hub. The institutes that could play a role in this development include CARMABI, TNO, NIOZ, Wageningen University, Naturalis and Deltares. Some already have research stations or departments in the Caribbean.

Tropical storms can cause severe damage to buildings and infrastructure. Island representatives asked whether researchers from the universities of technology could study and develop safer and more sustainable solutions.

It may be possible to join forces with the centres of excellence currently being set up in the Caribbean, for example on Aruba. There may also be opportunities for aligning projects with the priority programmes of the National Research Agenda, in particular the 'Blue Route' and 'Circular Economy and Resource Efficiency'. Rolling out these programmes in the Caribbean part of the Kingdom would yield added value for both research and the economy in the region.

### **Enforcement**

Enforcement was a common theme in all of the meetings. Often the necessary laws and regulations are in place, but compliance and enforcement are completely inadequate. Either there is a lack of enforcement capacity or the appropriate body has not been given a mandate for enforcement. A stronger effort is needed with regard to enforcement by public authorities (including the coastguard) and conservation NGOs, and there must be legal consequences for violations, such as commensurate fines and sentences. These aspects of enforcement can be worked out in more detail for the  $\Delta$ -Plan.

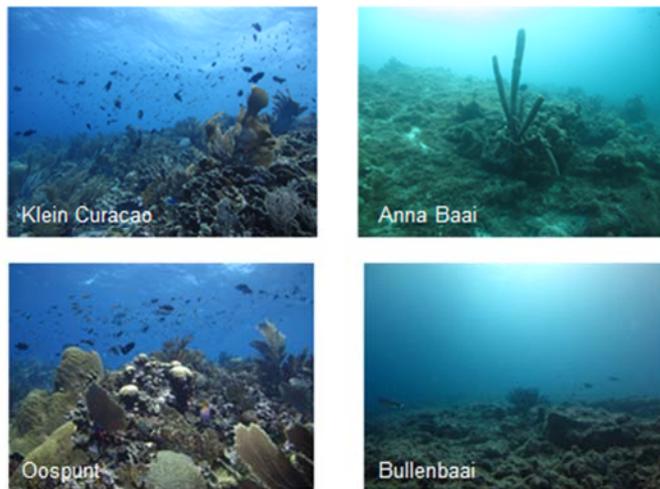
## 6. Suggested island-specific projects

This section describes, for each island, a number of possible projects that could be implemented. The descriptions are illustrative only and as such provide a basis for a rough estimate of the funding required. The task force will decide on the actual projects to be carried out.

### Curaçao

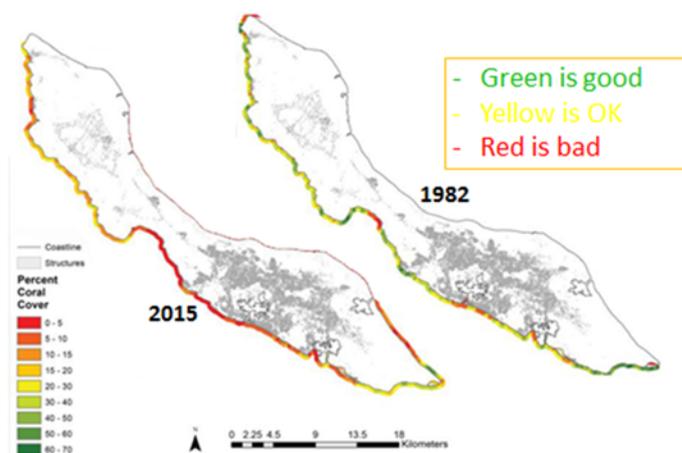
During his lecture, Jeremy Jackson showed photos of healthy and dying reefs around Curaçao.

#### *Healthy and dying reefs around Curaçao*



Klein Curaçao and Oostpunt are still beautiful; Sint Anna Bay and Bullen Bay are dying.

#### *Loss of corals over 33 years*



The data shows that the reefs are deteriorating rapidly along the entire coast. The figure above clearly illustrates the difference between 1982 and 2015. Data by Bakker et al. (2017)<sup>3</sup> shows that if the current trend continues many of the reefs will be gone in 15 years. However,

<sup>3</sup> De Bakker D.M., F.C. van Duyl, R.P.M. Bak, M. M. Nugues, G. Nieuwland, E.H. Meesters, 40 Years of benthic community change on the Caribbean reefs of Curacao and Bonaire: the rise of slimy cyanobacterial mats. *Coral reefs* 36, 2017, 355-367 (doi:10.1007/s00338-016-1534-9).



The 'Bring back the big fish' programme should also be implemented on Curaçao, for instance by introducing a number of additional no-take zones, including off Oostpunt. An Australian-style no-go zone could also be established to ensure that a few kilometres of coral reef remain absolutely pristine. A no-go zone is also easier to monitor. Monitoring and enforcement are needed to stop coral and sea cucumber poaching.

A mangrove marine park has been proposed to aid the restoration and maintenance of the mangroves. Initiatives for the protection of sea turtles deserve support. Wastewater treatment is ineffective and must be improved, in particular sewers that drain into the sea must be eliminated. Waste processing also needs to be improved. Currently, spent batteries are not collected separately. A large-scale approach combining waste processing, recycling and waste-to-energy is recommended. Drainage basins need to be improved by constructing water retention basins and taking measures to prevent flooding and erosion.

The refinery is a contentious issue. It creates a lot of jobs but is also a major emitter of thermal effluent and chemicals. Divers regularly see unknown substances flowing from the refinery into the sea. A policy prescribing zero discharge and reduced CO<sub>2</sub> emissions is needed, for both the coral and the climate. Government and industry can work together on this.

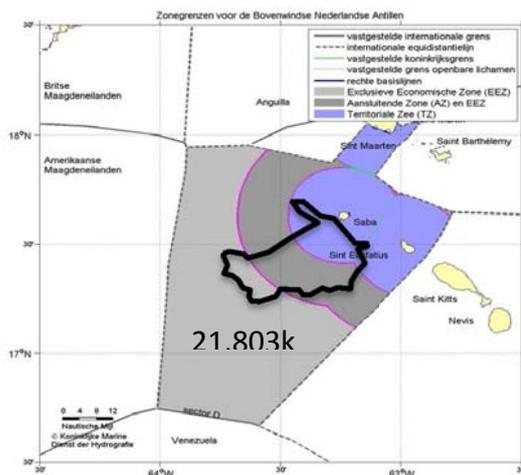
CARMABI (Caribbean Research and Management of Biodiversity) has a decades-long track record in marine research. The Smithsonian Museum of Natural History, CARMABI and Substation Curaçao have been working together for years within the Deep Reef Observation Project (DROP) and have discovered more than 30 new species in the deep reefs. It is also important for the  $\Delta$ -Plan that the government of Curaçao recently signed an MOU with CARMABI and the Curaçao Marine Research Center and set aside more than ANG 8 million for the further expansion of research facilities on the island. In recent years, Curaçao has positioned itself as a hotspot for marine research, and is therefore a crucial actor in the context of the  $\Delta$ -Plan.

The Historic Area of Willemstad, Inner City and Harbour of Curaçao is a UNESCO World Heritage Site, and the coral reefs around Curacao have also been nominated. This imposes special obligations that could be incorporated into and fulfilled within the  $\Delta$ -Plan.

## Saba

Saba has two national parks, Saba National Marine Park and Saba Bank National Park, which are managed by the Saba Conservation Foundation.

Saba Bank is the largest submerged carbonate platform in the Atlantic Ocean (the third largest in the world) and has one of the most biodiverse marine systems in the Caribbean. In 2010 it was designated Saba Bank National Park, and was granted official status as a National Park of the Netherlands in 2012.



The coral reefs of Saba Bank are in reasonable condition<sup>4</sup> and suffer little impact from land-based activity. Nevertheless, concerns about increasing algal cover deserve closer study. Furthermore, the area has been overfished in the past, so a large no-take zone is necessary to facilitate full recovery. As there are relatively few commercial fishers in the area, following Jackson's recommendations would appear to be a feasible undertaking. In a conversation with a fisher, it became clear that they are prepared to cooperate. A 'Bring back the big fish' project would therefore be likely to succeed. At present, the fishers have agreed to a six-month moratorium on redfish, during which action will be taken to selectively catch the highly destructive lionfish (an exotic species from Asia) using special traps. This could serve as a model project for the entire region. Additional financing (EUR 40,000) is needed.

People expressed concerns about commercial fishers from other parts of the world, such as China, and pressed for better control and enforcement.

Closer to the coast lies Saba National Marine Park, which is crucial for the island's recreational diving industry. Corals close to Saba are under pressure from land-based pollution and erosion. Erosion could be curbed through better coastal and land management; this should include measures to reduce the problem of free-grazing livestock (goats in particular). Saba will launch a programme to deal with this issue in the coming months.

<sup>4</sup> 10% coral cover on the bank's reefs cannot be considered 'good'. The reefs are still recovering from the last major bleaching event in 2005. Saba Bank is a good place to study the effects of climate change on coral reefs, especially if a fishing ban is imposed on part of the reef, because there is little local pollution (only Caribbean-wide pollution/eutrophication).

Near the harbour, which is used by dive operators, there is a stone crusher facility for making building material.



Stone crusher



dust clouds



and landfill site

The breeze blows fine particles from the large piles of grit and stone straight into the coral area. This problem could be solved by keeping the piles damp and improving management. Next to the crusher is an open landfill site. Saba has proposed that a large waste processing plant be built on St Maarten to process all the waste from the SSS islands efficiently.

Eutrophication is also a problem that could probably be alleviated through better wastewater treatment. At present, there would appear to be a lack of data to substantiate this; nutrient measurements are urgently needed. Other points for attention are water basin management, coastal erosion and the site for kitchen and garden waste. Saba would like more agricultural production and there is a tree-planting programme in place to restore the forest, but progress has been (too) slow due to funding and capacity shortfalls. EUR 100,000 a year is needed to accelerate these efforts.

## Bonaire

Bonaire's wastewater treatment is reasonable, but due to lack of funds nitrogen and phosphorus are not adequately removed from effluent. In addition, many more households and businesses need to be connected to the system.



Large wastewater treatment plant on Bonaire, investment EUR 40 million. The infrastructure is there but it needs to be put to optimal use.

Improvements should be made to the waste processing system.

Water basin management is needed here too. Creating more retention basins would benefit agriculture and help create jobs.

Changes in fisheries regulations could be implemented under a 'Bring back the big fish' programme. Public authorities prefer not to close more areas to fishing, but this could be an option if it were part of a total package of sustainable fisheries. Reforestation and the parrot project deserve more support. Various people I spoke to mentioned the cruise ships that call at the island, which cause a substantial increase in the tourism burden while revenues have been disappointing.



A cruise ship calling at Bonaire

Passengers currently pay a small landing fee, which could be raised (commensurate with other areas). There are complaints that when cruise ships enter port they displace a lot of sand, which seriously impacts the coral. They also generate a lot of noise over long periods, which is very disturbing to divers. It may be possible to solve these problems.

The government has indicated that it considers efforts to combat poverty to be a crucial part of the  $\Delta$ -Plan. It certainly provides scope for a large number of new jobs, but the question is whether it will benefit people who are currently living in poverty. An in-depth study of the target group is recommended (if this has not already been done), followed by a survey of innovative concepts that could be developed to make lasting economic participation a reality for this group. Cultural differences play a significant role in this. The  $\Delta$ -Plan could include an education and information component that specifically targets vulnerable groups.

## Aruba

Aruba urgently needs wastewater treatment plants as the concentrations of nitrogen and phosphorus flowing into coastal waters are much too high. For a long time, this has not been a problem thanks to the hydrological characteristics of the island, but recently unwanted algae and cyanobacterial mats have been encountered closer to the beaches.



At present Aruba's beaches are still beautiful, but what happens to all the wastewater produced by residents and all those big hotels?

Water basin management and new retention areas are needed. The south side of the island is heavily built up and the hydrological characteristics of the area have not always been taken into account. Hotels have beachfront gardens with primarily exotic plants that require more irrigation water and nutrients than local flora. Consequently, not only is wastewater a source of eutrophication, but so is the nutrient-rich run-off from these gardens. In addition, Palm Beach is a sensitive area because of its hydromorphology and piers.



Beautiful Arikok National Park and smouldering landfill on the other side of the island.

Improvements in waste processing are also necessary. Plastic bags were recently banned and this has had a positive impact. The island gives the impression of being clean and prosperous. However, the landfill site next to the airport causes major local pollution. Urgent and sweeping measures need to be taken to remedy this situation. I do not know whether there are any plans for centralised waste processing in the ABC islands, but if not, this could be considered.

It was also observed that the petroleum refining industry could be more closely involved in conservation. Introducing ecologically and economically sustainable industry on the coast could be included in the  $\Delta$ -Plan.

Information from and about Aruba is limited, and more research is needed. Aruba itself has no coral reef monitoring programme. A project has been launched to establish a marine park in 2018. Action is being taken to reduce the lionfish population, but on land the problem of free-grazing livestock has not yet been addressed.

Aruba is working to implement the Protocol Concerning Pollution from Land-Based Sources and Activities (LBS Protocol, 1999). Aruba does not have a tradition of spatial planning, nor of conservation and nature management. There is a strong drive to develop. That is why the 2009 Spatial Development Plan is being changed to allow more development, including the coastal zone. It is advisable to incorporate the problems and solutions from the  $\Delta$ -Plan into the Spatial Development Plan.

## St Eustatius

Coastal erosion is a problem on both sides of the island, with land and cliffs eroding and sediment being deposited on the coral reefs. Water system management is in urgent need of improvement. The Lievense Agency has identified and elaborated structural solutions to problems for each drainage basin. The minimum estimated budget is USD 5.5 million. The programme includes new retention basins that could be crucial to the further development of sustainable agriculture.



Every major rainfall further erodes the north coast, the cliff edge encroaches on the airport and waste falls into the sea

There is debate about using the natural area on the coast as a port and an anchorage for oil tankers waiting to load or unload. When oil tankers drop anchor they cause enormous damage to the coral reef, which has largely disappeared there. It is recommended that the use of anchor buoys be investigated as a better alternative. In initial interviews, concerns were expressed that this would be too costly. However, upon inquiry, buoy suppliers reported that EUR 1 million would go a long way to solving the problem. This could be taken up in cooperation with local government, industry and the St Eustatius National Marine Park.



Aerial view of the island and the oil terminal and, right, three ships at anchor

Free-grazing livestock are a major problem on St Eustatius and one of the primary causes of erosion. All donkeys, cattle and goats should be caught and kept in enclosures. Any remaining roaming animals should be culled. Most of the donkeys are now in enclosures and the cattle are currently being rounded up. The goats are next, but there is not enough money and capacity to do the job properly. It was suggested that EUR 500,000 would be enough to deal with this problem. Once it is resolved, it will be possible to develop sustainable agriculture and livestock farming, as on the other islands. Community-supported farming could be an option.



Overgrazing by roaming goats (left) and cattle (right) accelerates erosion

At present, there are new developments in the fishing industry that may lead to more boats fishing further afield. It is advisable to do this right and make haste with a sustainable fisheries programme, including a 'Bring back the big fish' project.

The island is also keen to expand tourism and is currently working on a ferry connection with St Maarten. Wagenborg, in partnership with NuStar, has serious plans for a daily service. If this gets off the ground, the ferry could bring tourists to the island from the cruise ships that call at St Maarten. (St Eustatius has historical significance for Americans because it was the first to acknowledge the independence of the United States of America.) The number of tourists should be attuned to the island's capacity. If tourist attractions like the botanical gardens are further developed and made accessible, this could create opportunities to reduce poverty on the island. For this to happen, though, the infrastructure on the island would need to be improved to ensure sustainable tourism. The  $\Delta$ -Plan could form the basis for continuing dialogue among the stakeholders. Education, capacity building and communication are essential here, too.

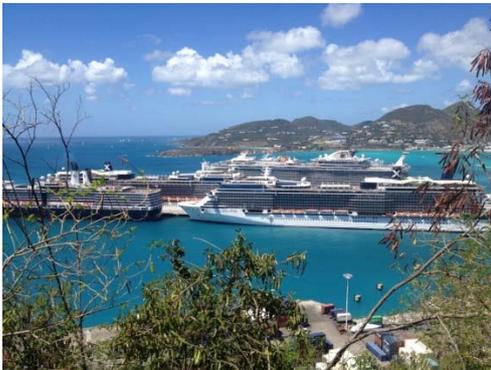
## St Maarten

St Maarten has severe problems processing its own waste and that left on the island by cruise ships. There is a large landfill in Great Salt Pond near Philipsburg where the rubbish pile is already 50 metres high. In March alone the dump caught fire twice and parts of the city had to be evacuated.



The landfill regularly catches fire and is a health and environmental hazard

The solution is to build a large waste-to-energy plant, a waste processing facility with high-quality incinerators that generate electricity (estimated cost: EUR 90-100 million, most of which must be pre-financed). The plant could also take on all the cruise ship waste. Saba supports this plan, as waste from Saba and St Eustatius could be shipped to St Maarten once a week for processing. Other neighbouring islands, such as St Barths, Anguilla and St Kitts could perhaps also use the facility.



Cruise ships bring a lot of tourists but also waste and pollution

Cruise ships are major sources of pollution and their waste is unloaded at St Maarten, adding to the island's waste management problems. It has been proposed that these vessels be connected directly to the power grid so that they can shut down their polluting engines while in port. The electricity generated from their waste in the waste-to-energy plant could be fed back to them through the grid, reducing their CO<sub>2</sub> emissions.

Sewage systems and wastewater treatment facilities need to be built or expanded.

St Maarten is improving its spatial planning. The authorities have formulated a draft spatial development strategy and there are draft land-use plans covering all of St Maarten. This is a lengthy process, which has been unnecessarily delayed by the political instability of recent years. Support from the Δ-Plan would help jumpstart this process. These land-use plans are

needed to steer spatial development in the right direction and to minimise land-based pollutants.

Hillside Conservation Areas are being established to protect elevated areas and prevent soil erosion and flooding downstream. In addition, a designated nature area will be established.

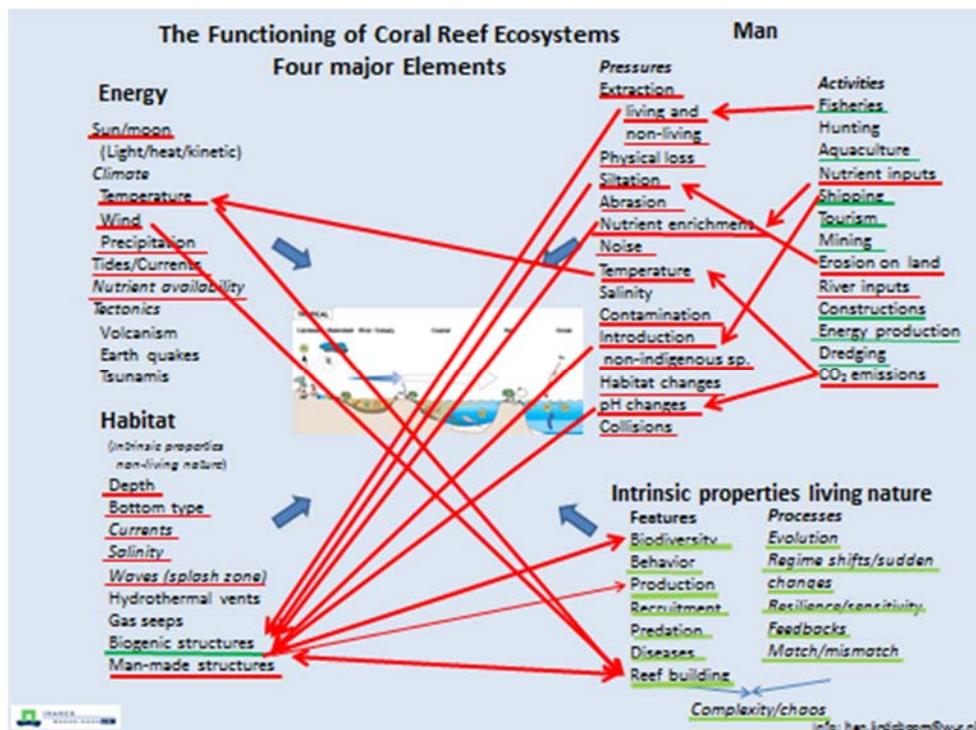
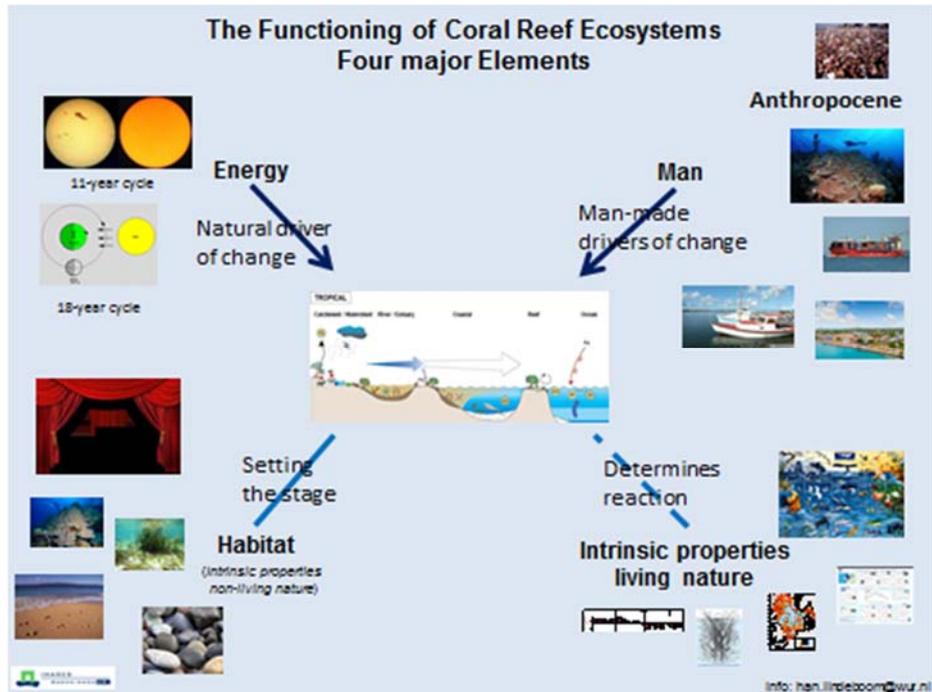
St Maarten's marine areas face the same threats as the other islands, such as lionfish, overfishing and low stocks of large fish species. It is recommended that St Maarten participate in the project 'Bring back the big fish'. The capacity and workforce of the Nature Foundation should also be increased so that the organisation is better able to fulfil its nature management tasks.

There are a number of highly destructive invasive species on the island, such as the green vervet monkey, mongoose and Cuban tree frog. A fauna management programme should be drawn up aimed at improving the management and/or control of invasive species. However, the funds, human resources and expertise needed to tackle this problem effectively are lacking.

Given St Maarten's geographical situation, good connections and other qualities, it would be an excellent location for a centre of expertise for coral reef conservation and management. There is also scope for developing the fisheries sector by stimulating the aquaculture of large fish species. These fish could either be released into the wild or sold for consumption to give wild fish stocks a chance to recover.

## Appendix

**Four elements** determine how coral ecosystems function. The habitat sets the stage, the amount of energy coming in determines natural variation, human beings are now the main drivers of change and the intrinsic properties of the ecosystem determine how it reacts.



The processes involved are represented by underlining and arrows. To stop the degradation of the coral reefs, it is necessary to seek solutions in a comprehensive approach to all manipulable variables – in other words, human causes of change.