Nexus interventions for small tropical islands: case study Bonaire

Tourism

Diana Slijkerman & René Henkens

WAGENINGEN
UNIVERSITY & RESEARCH

The economy of Bonaire leans heavily on incoming tourism, and depends largely on the values of the blue and green environment. Bonaire has an ambition to increase stay-over tourism with 60.000 tourists in the next 10 years, an increase of 47%. Although tourism development has unwanted impacts on the natural and social environment, the tourism sector is also increasingly recognised as a positive driver of change. From the nexus framework, new insights arise, which include the discussion among all relevant stakeholders of the value and destination of the surplus of waste water that will become available as a result of increased water production and use for tourism. As such tourism plays an important role in the NEXUS-approach. However, sustainable tourism growth should be the basic assumption in tourism ambitions. How to manage and monitor is discussed in this overview.

Current state	Desired state	Challenge	Nexus intervention
Annual number of tourists: Stay-over: 136.000 Cruise ship: 220.000 Ambition: increase of 60.000/year stay-over Pressures increase (habitat loss, sedimentation, pollution, disturbance of species)	Sustainable tourism developmen: make a positive impact on the environment, society, and economy instead of compromising negative impacts on one or more of these aspects.	Safeguard ecosystem intrinsic values and ecosystem services and thus its economic revenue. Sustainable tourism asks for Ecosystem-Based Management, which requires environmental monitoring programmes that are not undertaken yet. Mitigate pressures	Turn the surplus of water produced into valuable waste water destined for e.g. - Crop irrigation - Goat feed - Nature creation Leadership and policy in ecosystem based tourism/ island development.

Box 1. Summary factsheet NEXUS - Tourism

INTRODUCTION: CURRENT STATE, TRENDS & DRIVERS OF CHANGE

The economy of Bonaire leans heavily on incoming tourism. In 2016 the island welcomed almost 360 thousand tourists, mainly through air, so-called stay-over tourism (approx. 136.000) and cruise-ship (approx. 220.000). The direct contribution of the tourism industry to Bonaire's gross domestic product (GDP) is 16.4% (CBS, 2017) which is substantially higher if compared to the average contribution of 10.4% to global GDP (WTTC, 2018). The sector 'hotels and restaurants' generates nearly half of the total value added to GDP from the tourism sector. Recreational activities also play a major role, in particular scuba diving, snorkelling and water sports like wind and kitesurfing (CBS, 2017).

Most recreational activities (e.g. snorkelling, scuba diving) are highly dependent on healthy ecosystems such as coral reefs and their loss would impede a substantial economic loss for the island. Cado van der Lely et al (2013) assessed the Total Economic Value (TEV) of the terrestrial and marine ecosystem services at a yearly $105 million and they estimated a steep decrease to a TEV of $60 million within 10 years' time if conservation efforts would not be intensified.

Figure 1. The UNWTO recognises tourism as a driver for realizing the 17 sustainable development goals (source: http://tourism4sdgs.org/).

The Bonaire tourism sector is aware that its business depends on a healthy environment and it expressed this ambition in its vision "2017-2027 Tourism: Synergizing People & Nature for a Better Tomorrow, The Caribbean's 1st Blue Destination" (Croes et al, 2017). It foresees a tourism growth of 60.000 stay–over tourists in 10 years' time, which is generally in line which the regional growth patterns foreseen by the UN World Tourism Organisation (source: UNWTO Tourism Barometer) and the World Tourism and Travel Council (WTTC, 2018). In 2026 the number of stay-over tourist would then have increased by 47 % compared to 2016.

Though the negative impacts of the tourism industry should not be underestimated (see below), it's obvious that tourism also provides opportunities for the natural and social environment. The UN World Tourism Organisation considers the tourism industry as a driver for realizing the 17 sustainable development goals (SDGs, figure 1), some of which are linked to the NEXUS approach. For instance:

- **SDG 6**. Clean water and sanitation: Tourism can play a critical role in achieving water access and security. The efficient use of water in the tourism sector, coupled with appropriate safety measures, wastewater management, pollution control and technology efficiency can be key to safeguarding this resource.
- **SDG 7**. Affordable and clean energy: As a sector that requires substantial energy input, tourism can accelerate the shift towards renewable energy. By promoting sound and long-term investments in sustainable energy sources, tourism can help to reduce greenhouse gas emissions and mitigate climate change.
- **SDG 12**. Responsible consumption and production: The tourism sector needs to adopt sustainable consumption and production (SCP) modes, accelerating the shift towards sustainability. Tools to monitor sustainable development impacts for tourism, including energy, water, waste, biodiversity and job creation will result in enhanced economic, social and environmental outcomes.
- **SDG 14**. Life below water: Coastal and maritime tourism rely on healthy marine ecosystems. Tourism development must be a part of Integrated Coastal Zone Management in order to help conserve and preserve fragile marine ecosystems and serve as a vehicle to promote a blue economy, contributing to the sustainable use of marine resources.
- Other **SDGs** are however equally important, like SDG 4 – Quality education. Without training and education of local residents many tourism jobs will be fulfilled by expats, leaving the Bonairians behind.

Ecosystems can directly and indirectly be affected by tourism. Pressures are for example habitat loss due to e.g. construction for hotels or trampling of surfaces (seagrass), sedimentation (via construction-induced erosion), pollution (eutrophication, waste, sunscreens), and disturbance of species (e.g. flamingo's, sea turtles). Habitats and species can become stressed, and consequently decrease in quality and or quantity (see factsheet 'Ecosystem Nexus'). A sustainable use of the ecosystem is promoted in order to safeguard its intrinsic value and other important ecosystem services and thus its economic revenue (see factsheet 'Ecosystem Nexus') (Van der Lely et al., 2013).

DESIRED FUTURE STATE: SUSTAINABLE GROWTH

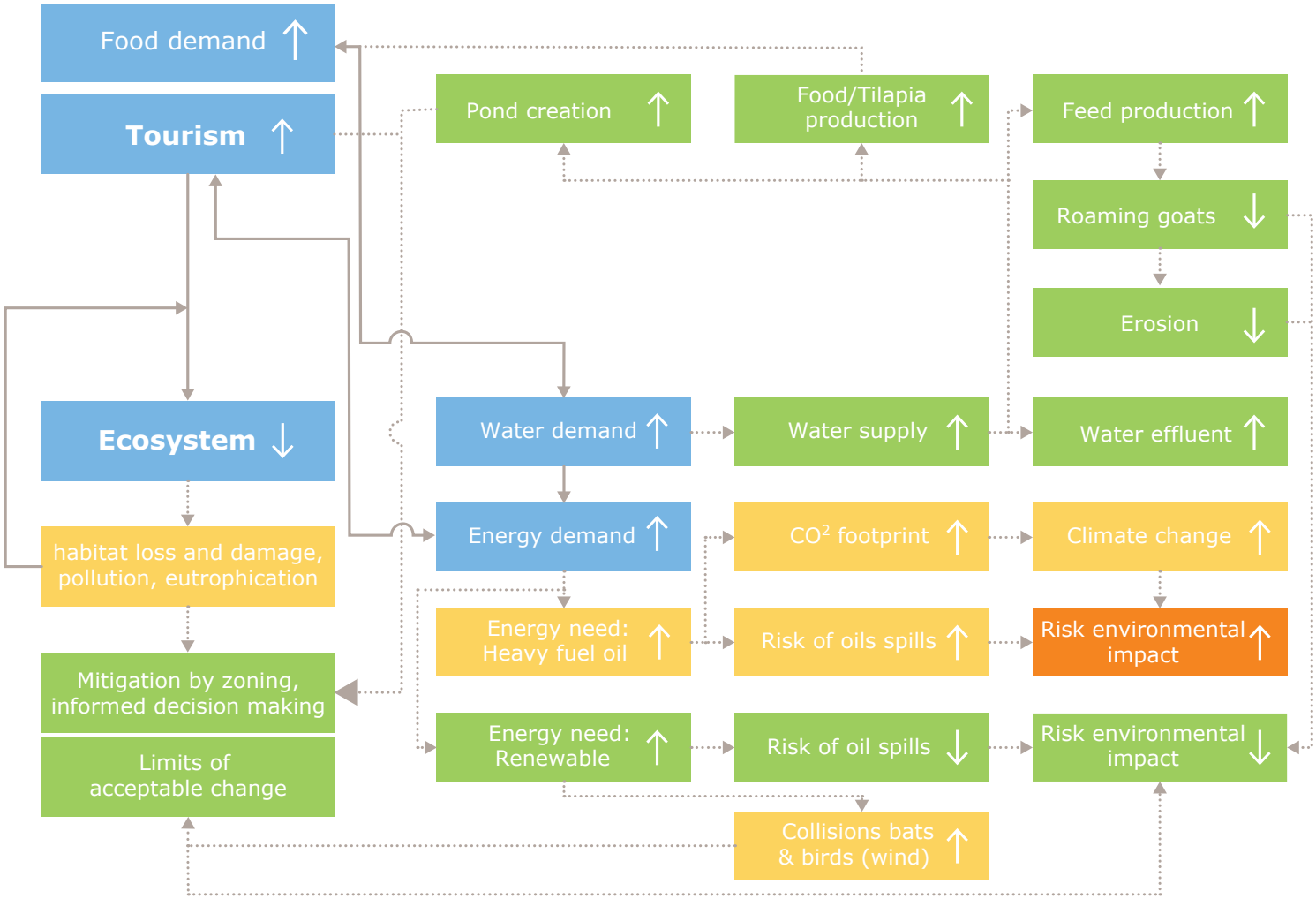
The ultimate aim is sustainable tourism, typified by having a positive impact on the environment, society, and economy instead of compromising negative impacts on one or more of these aspects. In this sheet we focus on the natural environment, as the natural environment is the driving factor for tourists to visit Bonaire.

POSSIBLE NEXUS INTERVENTIONS

As visualized in Figure 2, tourism can have both positive and negative feedback loops in the nexus.

Tourists use relatively much water. Water production on Bonaire is synchronised with the demand, meaning that an increase in tourist numbers will lead to increased production of fresh water (via reverse osmoses). Consequently, more waste water will be directed to the water treatment plant.
On average, each tourist on Bonaire consumes 150 litres of water/day, via e.g. sanitation (showers, toilets), laundry, and consumption (Hans Staring, WEB, personal communication). **An additional 60.000 stay-over tourists will thus lead to a surplus of 9000 m³ water/year.**

Figure 2. Nexus feedback loops from the tourism perspective. Blue: nexus domains. Green: positive feedback loop, yellow/orange: negative feedback loops.



Via a Nexus scheme (Figure 2), the positive feedback loop of increased tourism is visualised towards a positive effect on the ecosystem of the surplus water by tourists. As described in more detail in the corresponding factsheet 'Ecosystems Nexus', free-roaming cattle (goats) are a serious threat to Bonaire's ecosystems as they steer erosion via overgrazing the natural vegetation. Keeping goats in farms would save the natural vegetation from being grazed down, but would require water to produce goat feed/fodder (grass).

Freshwater is limited but the surplus water via increased tourism numbers, and thus increased water from the waste water treatment plant, can be allocated for the irrigation of agricultural land to grow crops for goat feed. As a result, more goats can be kept inside the kunuku's, consequently grazing in nature and subsequent impact of erosion can be reduced.

Table 1. Calculation of the water need by tourists in future, and the value of the surplus of this production in terms of fodder production for goats

What	Amount	Source
Number of tourists		
Current (2016) number of tourist	128,500/year. Equals 352/day	CBS (2017)
Increase of stay-over tourists	60000/year. Equals 164/day	Croes et al., (2017)
Future number of tourists	188500 in 2027. Equals 516/day	Calculated
Water use/demand by tourists		
Current water use/tourist/day	150l/day	WEB, personal communication Staring
Current water use/all tourists/year	19275 m^3/year	Calculated
Expected water use/all tourists/year in 2027	28275 m^3/year	Calculated
Increased volume of water used	9000 m^3/year	Calculated
Water treated and used in irrigation for grass production		
Current volume treated water (2017)	216000 m^3/year	WEB data (2017)
Treated water used for irrigation (total)	112000 m^3/year	WEB data (2017)
Extra treated water available in 2027 through increased tourism	9000 m^3 / year	Calculated (assumed equal to the extra demand and supply in water by tourists)
Water required per day for irrigation of 1 hectare of grassland		
Current use of treated water for irrigation grassland	40 m^3/hectare/day	Pers communication Van Almenkerk
Land that can be irrigated with extra treated water (+ 9000 m^3) available in 2027	0.62 hectare	Calculated
Relating fodder production/hectare to fodder consumption per goat		
32 hectares of grasslands feeds 3200 goats	1 hectare/100 goats	Pers communication Van Almenkerk
Number of goats that can be fed with fodder produced on the 0.62 hectare irrigated with extra treated water supply in 2027	62 goats	Calculated

In terms of "goat feed", the value of increased tourism can be expressed as: a total of 62 goats could potentially be fed by grass irrigated by the surplus water obtained from the additional 60.000 stay-over tourists. This calculation is based on the table below. Given the total number of 32.000 free roaming goats on Bonaire (Lagerveld et al, 2015), this small number of 62 goats may not seem as a significant added value. However, there are additional benefits from directing the surplus of treated waste water to irrigation of crops for goat feed, as access to this water will make it more profitable for people to start farming again on their often abandoned kunuku's. This will have positive impact on the livelihood of people living in the rural kunuku area, because it will reduce crime (i.e. theft), by increasing security (Lagerveld et al, 2015). In turn, increased security and farming activities, will raise common interest to improve the infrastructure in the kunuku areas, which again contributes to the livelihood of people living there.

However, this example shows just one Nexus intervention. In addition, figure 2 illustrates also other nexus feedback loops to be explored.

- Instead of directing it to agriculture for irrigation of fodder crops, the surplus of water can also be directed to other end-users, including:
  - Horticulture (aquaponics).
  - Ponds, which will attract birds and birdwatchers, like at the Bubali wetlands at Aruba.
  - Ponds, to grow freshwater fish (e.g. Tilapia) for human consumption However, the added value and suitability for consumption of fish has to be studied.
  - Revegetation programmes.
- The demand for extra water results in an increased demand for energy to produce fresh water. Choices should be made between heavy fuel oil, or renewable energy as source. Each choice has its own consequences on the CO^2 footprint, oil spill risks etc.
- The feedback loop "ecosystem demand" is elaborated in the next section.

The man-made Bubali wetland, Aruba

The wetland of Bubali (83.6 ha) is located on the north-west coast of Aruba. It is a former salina which receives effluent from the waste water treatment facility since the early seventies. The wetland has transformed in a mosaic of permanent open water, reed beds and mangrove forests. More than 120 bird species are recorded, often numbering several thousand during peak migration periods. As such, the area is a wetland of international importance, which is due to be designated as a Ramsar site. Apart from birds the site also attracts many bird watchers, which contributes to the local economy.

KNOWLEDGE NEEDS & CHALLENGES

Surplus water

The surplus of water can be directed to various end-users. The allocation of water, and knowledge needs are further elaborated in the factsheet 'Water Nexus'.

Sustainable tourism growth

In order for the tourism sector to contribute to sustainability goals, it must be formalised what sustainability means. Debrot et al. (2019) assessed the current conservation status of all habitats and species in the Caribbean Netherlands. Yet, goals should be set about the preferred conservation status of habitats and species, like the percentage of life coral cover, the density of seagrass beds or the population number of (indicator) species.

Depending on the status, the limit of acceptable change should be set. E.g. with the current decreasing trend of cover and quality, it can be debated whether or not a continuing decline is acceptable. Also, a positive trend alone, like for the current increasing number of yellow-shouldered parrots, is not enough if its numbers are still below a set limit of acceptable change (LAC): currently its population is still small and threatened. In addition, care should be taken towards the so called "shifting baseline".

Such thresholds or LACs are known from the European Netherlands, like for fisheries species (Figure 3; CBS et al. 2018). Carrying capacity studies are an alternative manner.

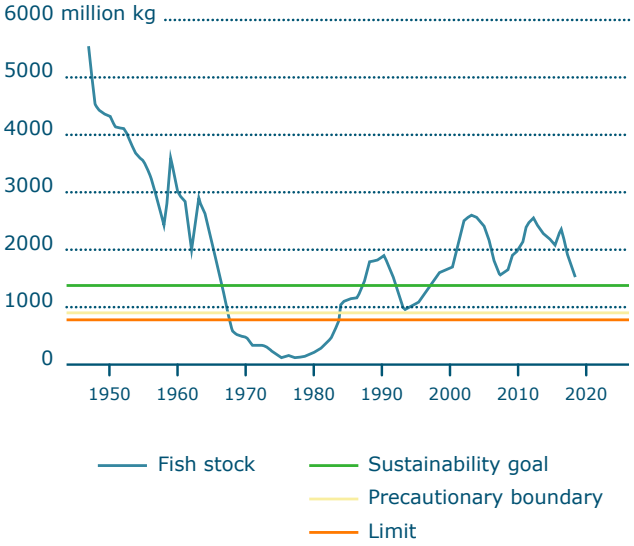


Figure 3. Example of a Limit of Acceptable Change (LAC) for the Herring in The Netherlands. The yellow precautionary boundary indicates a population level beneath which measures should be taken (LAC), while the red-purple boundary indicates the level beneath which reproduction failures are to be expected. The green line represents the sustainability goal (CBS et al. 2018).

Measures must be taken if the conservation status of habitats or species surpasses a certain LAC. This can be measures in different fields, preferably measures that mitigate the most substantial threats. This might be tourism, but the threats from free-roaming goats, invasive species, pollution or fisheries are often much more substantial (Debrot et al., 2018). These threats should be monitored as well, like for major threats in The Netherlands (figure 4).

The analysis of both long-term trends of nature indicators and its major threats indicates which measures should be taken to achieve a sustainable conservation status of the natural environment in combination with its exploitation. The complex relations between habitats, species and its threats request a modelling approach. The Meta Natuur Planner (MNP) is the model developed by Wageningen Environmental Research and used by the "Plan Buro voor de Leefomgeving (PBL) to assess the state of nature. It provides policy advise through publications like the national Balans van de Leefomgeving (PBL 2017). Other options are semi-quantitative modelling of risks and impacts (see factsheet 'Ecosystem'). These generic models might have added value for small tropical islands, by helping to assess and set the level of sustainable exploitation such as tourism.

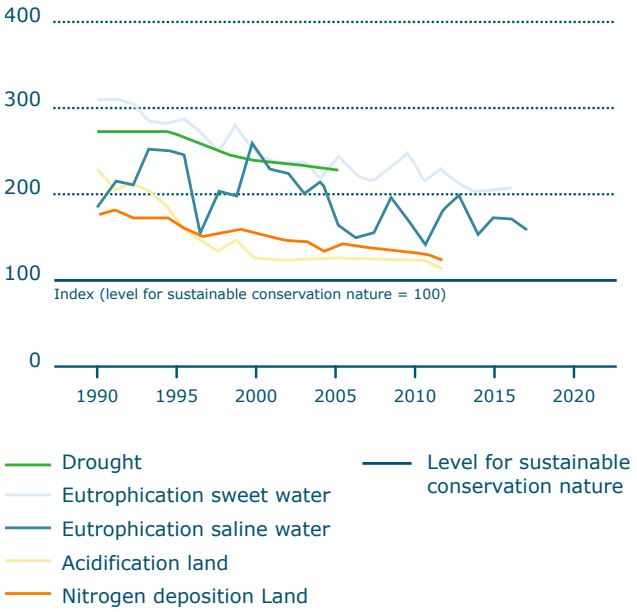


Figure 4. Example of long-term monitoring of major environmental threats in The Netherlands, like drought, eutrophication and acidification. The 100-line indicates the level below which the impact is considered to threaten the conservation status of nature.

GOVERNANCE

It is currently unclear who is setting the goals for sustainable tourism (e.g. number of people, number of cruise ships). Sustainability limits should be discussed in terms of ecosystem, social (residents) and psychological (experience value) carrying capacity, and limits in managerial capacity. Is this a responsibility of the tourism sector (cooperate social responsibility) or should the Island Counsel set strategic goals for sustainable tourism development?

Leadership: allocation of long term biodiversity monitoring responsibilities, budgets, capacity, and lab facilities. What is the role and responsibility of the Netherlands and the Island?

STINAPA plays a central role in management of marine and terrestrial nature on Bonaire. Besides that, they are key stakeholder in tourism development as they are financially dependent on nature fees and thus the number of tourists. This potential controversy can conflict with the ambitions and responsibilities of their co-stakeholders under the Blue Destination ambition, the Chamber of Commerce and Tourism Board, which both have interest in tourism growth from an economic and social perspective. Shared fact finding and vision could be key in sustainable future collaboration.

TO CONCLUDE & WAY FORWARD

Ecosystem services are key in the Water-Food-Energy-Ecosystem Nexus for small tropical islands like Bonaire (see factsheet 'Ecosystem'). Drafting nexus linkages from the tourism perspective provided new insights on the provisioning of fresh water, and the allocation of the surplus water produced to the ecosystem or agricultural landscape. Next step would be to discuss with all stakeholders, what the most beneficiary and efficient allocation of surplus water could be.

Sustainable development of tourism requests shared fact finding, for which long term monitoring on values (ecological and economical, pressures and stakes) should be the basis. Leadership, capacity, strategy and allocation of budget are key issues that are currently missing.

Research agenda

- Communication with all stakeholders (which goals, how, who, set up, results) in order to increase shared fact finding and shared measures in future
- Long term monitoring of habitats, species, pressures:
  - Develop indicators for sustainable tourism for the Caribbean Netherlands, like the many indicators available on biodiversity and threats at the Environmental Data Compendium for the Netherlands (https://www.clo.nl/)
  - Set budgets
- Select responsible departments and allocate capacity

References

CBS, PBL, RIVM, WUR (2016). Milieucondities in water en natuurgebieden, 1990 - 2014(indicator 1522, versie 05 , 3 augustus 2016). www.clo.nl. Centraal Bureau voor de Statistiek (CBS), Den Haag; PBL Planbureau voor de Leefomgeving, Den Haag; RIVM Rijksinstituut voor Volksgezondheid en Milieu, Bilthoven; en Wageningen University and Research, Wageningen.

CBS, 2017. Trends in the Caribbean Netherlands 2017. Statistics Netherlands, The Hague/Heerlen/Bonaire: 126p.

CBS, PBL, RIVM, WUR (2018). Visbestanden in de Noordzee, 1947-2018 (indicator 0073, versie 19 , 21 augustus 2018). www.clo.nl. Centraal Bureau voor de Statistiek (CBS), Den Haag; PBL Planbureau voor de Leefomgeving, Den Haag; RIVM Rijksinstituut voor Volksgezondheid en Milieu, Bilthoven; en Wageningen University and Research, Wageningen.

Croes, Robertico; Rivera, Manuel A.; Semrad, Kelly J.; Shapoval, Valeriya; and van Niekerk, Mathilda, "2017-2027 Tourism: Synergizing People & Nature for a Better Tomorrow, The Caribbean's 1st Blue Destination" (2017). Dick Pope Sr. Institute Publications. 45. http://stars.library.ucf.edu/dickpope-pubs/45

Debrot, A.O., Henkens, R.J.H.G., Verweij, P.J.F.M. (reds.), 2018. Staat van de natuur van Caribisch Nederland 2017: Een eerste beoordeling van de staat (van instandhouding), bedreigingen en managementimplicaties van habitats en soorten in Caribisch Nederland. Wageningen Marine Research Wageningen UR (University & Research centre), Wageningen Marine Research rapport C086/17. 214 p.

Lagerveld, S., D. Debrot, P. Bertuol, N. Davaasuren, and F. Neijenhuis. 2015. Populatieschatting geiten op Bonaire. IMARES Wageningen UR (University & Research centre), IMARES Rapport C115/15. 48 p.
PBL, 2017. Tussenbalans van de Leefomgeving 2017. PBL Planbureau voor de Leefomgeving Den Haag, 2017 PBL-publicatienummer: 2908. 48blz.

Cado van der Lely, P. Van Beukering, L. Muresan, D.Z. Cortes, E. Wolfs, S. Schep (2013) The Total Economic Value of Nature on Bonaire. IVM Institute for Environmental Studies, Amsterdam (2013).
WTTC, 2018. TRAVEL & TOURISM ECONOMIC IMPACT 2018 CARRIBEAN. World Travel and Tourism Council, London, UK. 24p.

Colophon

January 2019

Authors: Diana Slijkerman, René Henkens

Reviewer: Matthijs van der Geest

Graphic design and lay out: Kinga Bachem

The KB program "Nexus Strategic policy case", included a Bonaire NEXUS case study. The case study was funded under KB-33-005-013, and administered under project number 4318300087. A letter report (number 1900369.ds) summarises the activities. In the study a set of 8 factsheets was drafted (and attached to the letter report). The set of factsheets can be found on : www.wur.eu/sustainablewatermanagement
factsheets was drafted which can be found on : www.wur.eu/sustainablewatermanagement