

**Better environmental management of the
Simpson Bay Lagoon pays off**

For the environment, society, and the economy

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Summary

Similar to many other Caribbean coastal wetlands, the Simpson Bay Lagoon suffers from heavy development, wastewater pollution, and overexploitation. These pressures have severely degraded the ecological integrity of the lagoon. Almost all mangrove forests have been removed for development, and sewage inflow and illegal waste dumping have deteriorated the water quality. This is problematic, not only for ecological reasons, but also because local livelihoods depend on the ecosystem services provided by the lagoon. This policy brief provides a summary of three studies that have been conducted on the Simpson Bay Lagoon in the period March 2019 to June 2019, respectively focussing on the three pillars of the Triple Bottom Line – Planet, People & Profit. Central in these three studies was the implementation of a household survey in Saint Martin, in which 219 households were interviewed about how they perceive and value the Simpson Bay Lagoon.

The “Planet” study mainly focused on the water quality in the lagoon, and identified the main pollution sources. This study found that in many parts of the lagoon, the levels of nitrate-nitrogen, total coliform and faecal coliform were unacceptably high, and often rising over time. This further confirms the acute problem of poor water quality in the lagoon. The main identified pollution sources were sewage discharge, destruction from development, sunken boats, domestic waste pollution, and the release of toxic chemicals in the lagoon.

The “People” study assessed the issue from a societal perspective. It shows that the population of Saint Martin greatly values the Simpson Bay Lagoon, given their high willingness to pay for more environmental management. The survey results revealed that the degrading environmental condition of the lagoon was noticed by the vast majority of the respondents. People also highly supported better environmental management of the lagoon (e.g. through mangrove restoration or building a sewage treatment plant). The results further signify that more educational opportunities could change the resident’s environmental behaviour in a positive way. Engaging the public to come more into contact with nature, for instance by involving them in recreational activities, could lead to improved environmental behaviour as well.

The results of the “Profit” study, the economic analysis, show a clear economic rationale for improved environmental management of the Simpson Bay Lagoon. The study reveals that although the current total economic value of the lagoon is still nearly US\$20 million per year, this value would nearly be completely lost if the current business-as-usual scenario continues. This decline can be avoided by intervening in the lagoon. Mangrove restoration or the installation of a sewage treatment plant would significantly raise the annual economic value to US\$28 or US\$31 million, respectively. A cost-benefit analysis reveals that the benefits of mangrove restoration and the construction of a sewage treatment plant far outweigh their costs, and that in all aspects these environmental management scenarios economically outperform a business-as-usual scenario.

Overall, the results of all three studies imply that better environmental management of the lagoon is highly needed, simultaneously benefiting the environment, society, and the economy. Opportunities to improve environmental management are ubiquitous; it is now the turn of local policy makers to put them into practice.

1 Introduction

The Simpson Bay Lagoon in Saint Martin is threatened by pollution and degradation. This has detrimental impacts on the ecological integrity of the lagoon and on the local livelihoods that depend on the lagoon's provisioning of ecosystem services. This policy brief integrates three pieces of research that focus on the three pillars of the Triple Bottom Line – Planet, People & Profit. The “Planet” study focused on the water quality in the lagoon and identified the main pollution sources. This study is summarized in Chapter 2 of this policy brief. The “People” study researched the perceptions of the local community of Saint Martin regarding the environmental degradation of the lagoon. This study is summarized in Chapter 3. The “Profit” study assessed the (potential) economic value of the lagoon, and analysed the costs and benefits of alternative environmental management scenarios for the lagoon. This study is summarized in Chapter 4. Looking at the developments in the Simpson Bay Lagoon from an environmental, social, and economic perspective generates a comprehensive overview and offers important insights to local policymakers and the public alike. Chapter 5 provides an overarching conclusion of the three studies and gives the main policy recommendations.

2 Water quality in the Simpson Bay Lagoon and main sources of pollution

Water pollution in the lagoon has been identified as a pressing issue which has severe negative effects on the ecological state of the lagoon and on the surrounding ecosystems, as well as on the well-being of Saint Martin's residents¹.

To examine the water quality issue, previously collected water quality data were assessed (collected by Nature Foundation and EPIC). Moreover, new water quality tests were carried out in May 2019. Furthermore, interviews with key informants and a literature review were used to identify the main sources of water pollution.

2.1 Water quality in the lagoon

This study assessed existing and new water quality data for three parameters: total coliform, faecal coliform and nitrate-nitrogen (NH₃).

Total and faecal coliform

Coliform bacteria can be of faecal or non-faecal origin. Although coliform bacteria are not harmful themselves, their presence can indicate the presence of other pathogenic viruses or bacteria that also occur in faeces. Examples of waterborne diseases caused by such bacteria include viral and bacterial gastroenteritis, salmonellosis, staff and ear infections, dysentery, typhoid fever, and hepatitis A. Furthermore, insufficiently treated sewage is harmful to aquatic life.

Water quality tests by EPIC conducted in 2009 provided detailed results of the presence of total coliform colonies in the lagoon. Sites in the Cole Bay corner and near the American University in the Caribbean exhibited very high levels of total coliform contamination. Sites at Cole Bay, La Sucriere and the Airport also showed a high presence of total coliform bacteria. On the other hand, the Mullet Pond site exhibited a relatively low level of total coliform (Figure 1).

The study conducted in May 2019 tested the presence or absence of total coliform bacteria at 13 sites. All sites tested positive for total coliform bacteria. A particularly striking result is the presence of total coliform bacteria at the Mullet Pond site, which tested negative for total coliform in 2018. Figure 2 shows the coliform test results, rated on a 3-point scale from low to high.

Faecal coliform testing conducted by EPIC in 2009 revealed alarming results. Almost all sites demonstrated extremely high levels of faecal coliform, with some sites having too many colonies to count. In particular, areas in Cole Bay exhibited an extremely high level of faecal coliform with one site having an average count of approximately 110,000 colonies per 100 ml and another approximately 10,000 colonies per 100 ml. The Ministry of the Netherlands Antilles has set the norm at 200 colonies/100 ml as the acceptable level of faecal coliform for bathing water.

¹ This chapter will provide a short overview of the extensive water quality testing that was performed in this study. The thesis published on the website of EPIC can be consulted for more detailed information: <http://epicislands.org/publications.html>

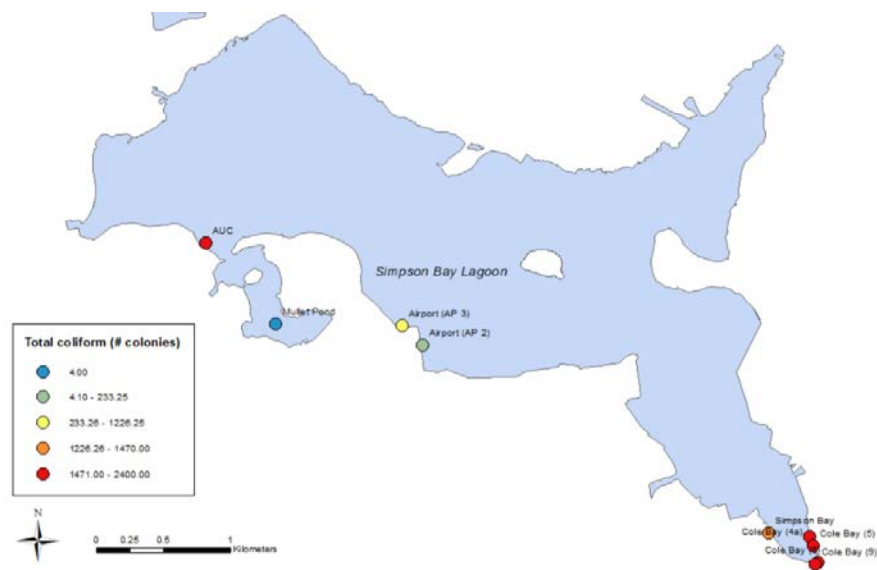


Figure 1 Total coliform test results from 2009

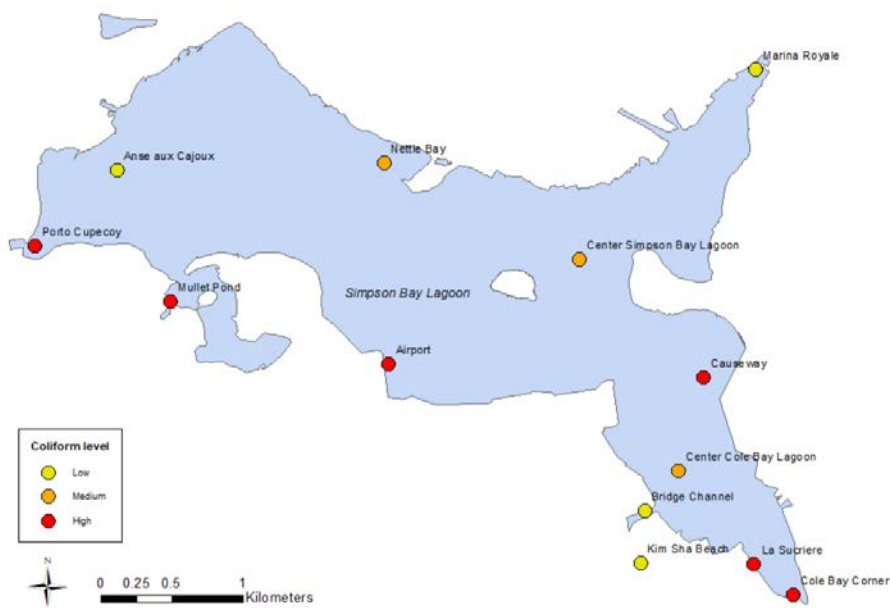


Figure 2 Total coliform test results from May 2019

Nitrate-nitrogen

The main sources of nitrate-nitrogen added to natural waters are normally sewage and agricultural runoff. Elevated nitrogen levels cause excessive plant growth, leading to increased plant decay and decreased oxygen availability. This process of eutrophication causes “dead zones” to appear in water bodies where no plant and animal species can survive. Elevated nitrogen levels can also have a negative effect on human health and well-being. According to the U.S. Environmental Protection Agency (EPA), eutrophication can lead to severe adverse health effects if humans consume polluted fish, come in contact with water, or ingest contaminated water. Normal levels of nitrate-nitrogen are below 1 mg/l, water becomes toxic to some fish at 5 mg/l, and at levels of 7 mg/l or higher even nitrogen-tolerant fish begin to die.

The levels of nitrate-nitrogen were tested by Nature Foundation in 2013, 2018 and 2019 at four sites in or near the Simpson Bay Lagoon: Cole Bay Lagoon, Kim Sha Beach, Mullet Pond, and Bridge Channel. All sites exhibited normal levels of nitrate (below 1 mg/l), with the Bridge Channel site showing an elevated level of nitrates of 8 mg/l.

Nitrate levels were also tested in May 2019 in and near the lagoon. All sites, with exception of Cole Bay Corner, Cole Bay La Sucriere, and Bridge Channel showed nitrate levels lower than 5 mg/l. La Sucriere and Bridge Channel showed a level of approximately 7 mg/l. Cole Bay Corner showed a very high level of nitrate-nitrogen of approximately 10 mg/l.

2.2 Main environmental stresses

Sewage discharge

Currently, the main source of pollution in the lagoon is untreated or minimally treated sewage that is discharged directly into the lagoon from land-based point sources, such as households and businesses neighbouring the lagoon. All areas surrounding the lagoon on the Dutch side do not have access to an industrial wastewater treatment plant and instead rely on septic systems. Residents on the French side are connected to a municipal sewage system which will, however, soon exceed capacity. From reports by EPIC, Nature Foundation, and various Saint Martin news outlets, it is evident that septic tanks on the island regularly overflow. Sewage pollution from land-based sources is an ongoing issue that threatens marine ecosystems as well as human health. Sewage discharge from boats continues to be an additional issue as well.

Sunken boats

During Hurricane Irma, approximately 200 boats sank on the Dutch side and 200 on the French side. Still, many of these boats have not been salvaged. The longer the boats remain in the water, the more they are leaking battery acid and other chemicals into the lagoon.

Development and mangrove destruction

Mangroves carry out many important ecological functions. Mangrove roots serve as a breeding habitat for fish and other marine species, while the branches serve as a habitat for birds and as food for pollinators. Additionally, mangroves have an important water purification function, with the plants being able to remove pollutants from the water. Furthermore, mangroves can protect nearby properties from storm damage.

However, on Saint Martin, there has been an overall trend of mangrove destruction, with natural areas being replaced with construction and new development. Due to extensive development around the lagoon, 90% of the original mangrove stands have been destroyed. Construction plans around the lagoon are ongoing and almost always ignore the negative environmental impact. The majority of these projects involve the destruction of natural habitats, as well as extensive dredging and filling in, which damages fragile natural areas and causes water pollution.

Domestic waste pollution

Domestic waste pollution is an additional important source of environmental stress in the lagoon. Although it is illegal to litter and leave waste on the side of the road in Saint Martin, it is a very common practice resulting in roads lined with litter. Recycling and waste separation facilities on the French and especially the Dutch side of the island are limited, with the bulk of household waste deposited at the Philipsburg landfill. Heavy rains and winds can transport domestic waste towards the water or into the drains that are flowing into the lagoon. Household litter can include not only biodegradable products, but also plastics, electronics and hazardous chemicals such as oils and paints.

Toxic chemical pollution

The lagoon is the centre for the boating and yachting industry of Saint Martin, which comprises 12.5% of its economy. There are approximately 15 large docks and marinas and 5 boatyard areas situated on the lagoon. There is evidence that instead of using dry docks for painting and other boat repair, boat owners frequently complete this work on the water at their marina or when anchored in the lagoon. This leads to toxic chemicals such as paints and other products being discharged directly into the water.

Furthermore, some hazardous products which are banned in most parts of the world, are still being used and sold on Saint Martin. These products are used for boat protection and cleaning, and often contain toxic chemicals which have been proven to be harmful to marine ecosystems and humans. In particular, antifouling self-polishing copolymer (SPC) paints are still sold on Saint Martin. SPC paints are toxic to a wide range of marine species, and through bioaccumulation can also negatively impact human health. Such paints are banned in all EU ports as well as globally for both application and presence on ships (according to the International Convention on the Control of Harmful Anti-fouling Systems on Ships).

2.3 Overall assessment of water pollution

The results of the water quality testing revealed that the water in the Simpson Bay Lagoon is highly polluted, and thereby has the potential to have detrimental effects on ecosystems and human health. Especially the results for total and faecal coliform are alarming, and should spark the immediate interest of local decision makers. There are many ways to significantly reduce the pollution of the lagoon. These include the installation of a sewage treatment plant, mangrove restoration, the removal of sunken boats, controlling domestic waste pollution, forbidding the sale of globally banned chemical products, and prohibiting the use of toxic chemicals near the water. Nevertheless, strong enforcement of environmental regulations is a necessary condition for these measures to be successful.

3 The Simpson Bay Lagoon from a socio-cultural perspective

Studying the Simpson Bay Lagoon from a “People” perspective is of key importance. It reveals what the lagoon means to the local people of Saint Martin and how local people envision the future of the lagoon. Furthermore, it gives insights on the environmental behaviour of local people, which directly impacts the environment of Saint Martin. In addition, the proposed environmental management scenarios will only succeed and be justified if they are supported by the public.

3.1 Environmental attitudes, recreation and well-being

When asked about their self-perceived environmental awareness, most of the 219 respondents stated to be (very much) environmentally aware, which is also partly visible in the type of environmental activity they participate in. Figure 3 show that most people avoid littering, but that they rarely donate money to environmental organizations or conduct voluntary environmental work. Relating these results to demographic variables reveals that respondents with a higher level of education and a higher income level are more environmentally aware and participate more in environmental activities.

In the survey, respondents were also asked if and how often they participated in different recreational activities on the lagoon in the past year. The results reveal that in general few people participate in recreational activities on the lagoon, which might be due to its highly polluted state. Nevertheless, many respondents stated that their well-being depends on the lagoon. Figure 4 shows that for most people the lagoon is important for its cultural and historical value, for social interaction with other people, and for their well-being in general. For many people, the lagoon also impacts their income or health.

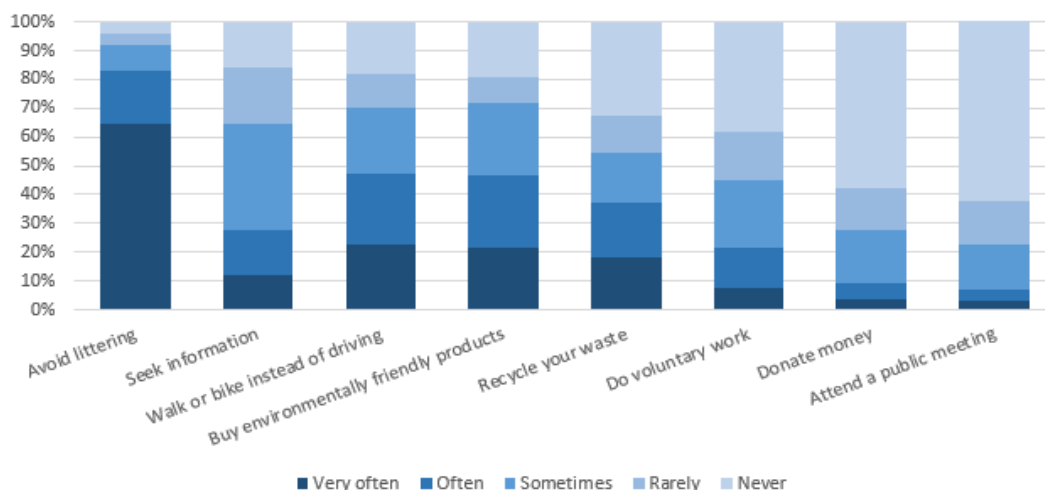


Figure 3 Participation rate in activities related to the environment

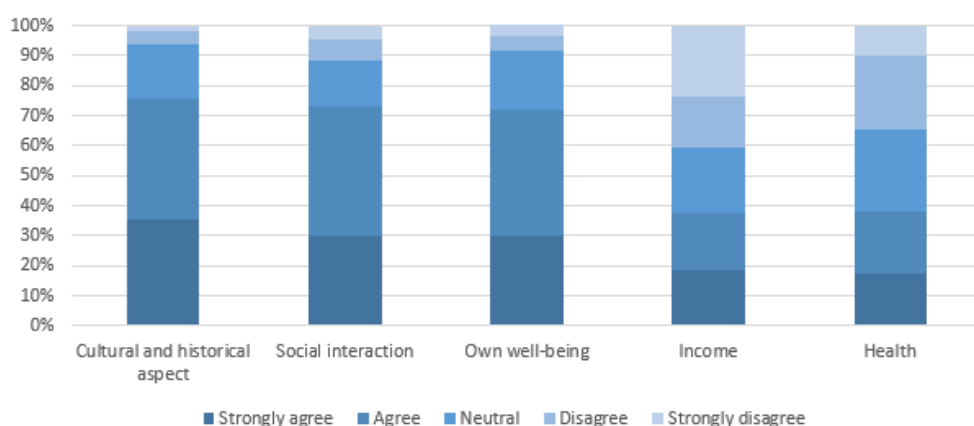


Figure 4 Statement questions linking well-being and the Simpson Bay Lagoon

3.2 Perceptions of and solutions to the environmental problem

Of all respondents, 78% indicated that they noticed changes in the lagoon’s environmental condition over the past 10 years or since they arrived on Saint Martin. When asked about the specific changes they noticed, most respondents mentioned trash and plastic pollution and dirty water. Bad smell and less fish in the water were also frequently mentioned. Respondents were also asked to indicate how important they perceived some causes of the poor environmental condition of the Simpson Bay Lagoon. Sewage and garbage pollution are mentioned as the most important causes. Furthermore, respondents were asked about who they thought were most responsible for the poor environmental condition of the lagoon. The vast majority of the respondents perceived the government to be most responsible, followed by businesses. To assess public support for improved environmental management of the lagoon, six different environmental management options were presented to the respondents (see Figure 5). For all of them, more than 60% of the respondents indicated that they were in favour or highly in favour of implementing them. Raising environmental awareness was supported the most, followed by enforcing environmental regulations and removing shipwrecks. The management option with the lowest level of support was the restriction of development and construction.

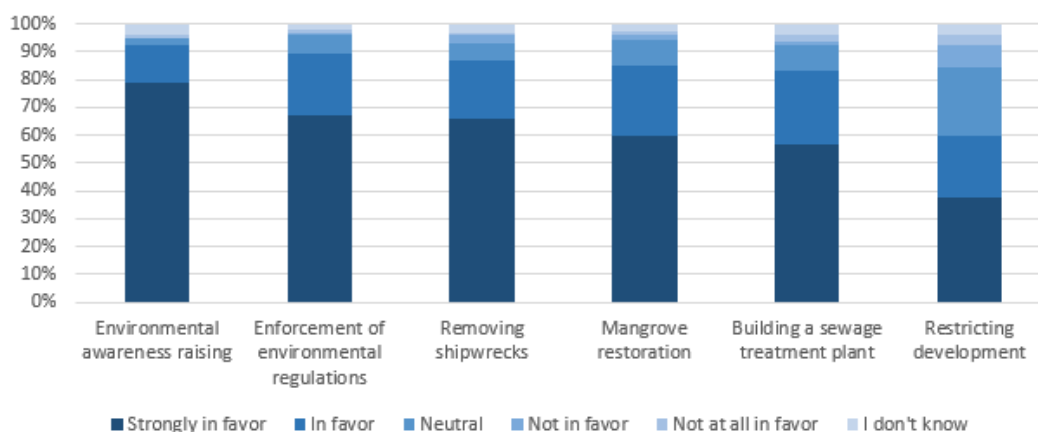


Figure 5 Relative support for different management options

3.3 Willingness to pay for environmental management

When asked if and how much the respondents were willing to pay for environmental management of the Simpson Bay Lagoon, 77% of the respondents were in principle willing to pay. The mean willingness to pay was US\$14 dollars per household per month, ranging from US\$2 to US\$125. Participants were also asked which organization should manage the funds for environmental management of the lagoon. The large majority of the respondents wanted local environmental organizations to manage the funds.

The willingness-to-pay values were related to different demographic variables and questions asked in the survey. The results of this analysis show that respondents with a higher education and income level, higher environmental awareness and higher environmental participation have a higher willingness to pay for environmental management of the lagoon. This also holds for people who recreate more on the lagoon. Furthermore, people who are more dependent on the lagoon for their well-being, for instance because their income depends on the lagoon, display a higher willingness to pay for environmental management of the lagoon.

3.4 Overall implications of the socio-cultural study

The results of the “People” study show that many people recognize the ecological disaster that is unfolding in the Simpson Bay Lagoon. The large majority of the survey respondents are in favour of implementing measures to improve the environmental condition of the lagoon. These include the installation of a sewage treatment plant, mangrove restoration, and the removal of shipwrecks in the lagoon. Many people would be willing to pay a considerable amount per month for better environmental management of the lagoon. This implies that if the government of Saint Martin wants to represent the voice of the people, it should take the necessary measures to improve the ecological integrity of the lagoon. In addition, this study showed that people with higher education levels and people who participate more in recreational activities display more positive attitudes towards the environment and more environmentally friendly behaviour. Hence, this shows the importance of improved education, environmental campaigns and facilitating recreational opportunities on Saint Martin.

4 The economics of environmental management of the Simpson Bay Lagoon

The results of the “Planet” and “People” study have shown that better environmental management of the lagoon would pay off for both the environment and society of Saint Martin. The following “Profit” study assessed if better environmental management of the lagoon also pays off economically. The economic study on the Simpson Bay Lagoon consisted of two parts: an economic valuation of the Simpson Bay Lagoon and a cost-benefit analysis of alternative environmental management scenarios.

4.1 The economic value of the lagoon

Importance for residents

To obtain the economic value of the lagoon for the residents of Saint Martin, a survey was conducted among the local population, interviewing in total 219 residents. Several steps were taken to ensure that the study sample was representative for the whole population of Saint Martin. This included interviewing people from both the Dutch and the French side of the island, and targeting people from different neighbourhoods in proportion to their population size. In total, 131 of the 219 respondents were from the Dutch side of the island, and 88 from the French side.

The survey contained a choice experiment in which respondents were asked to choose between different hypothetical scenarios representing different levels of pollution of the lagoon. Aspects that respondents were asked to consider included different levels of storm damage, water quality, habitat for species, recreational opportunities, number of stay-over tourists, and a monthly payment for environmental management. These scenarios were presented to the respondents in the form of a choice card. The inclusion of a monthly payment as one of the choice attributes made it possible to estimate the economic value of different future scenarios for the Simpson Bay Lagoon². The results of the choice experiment showed that the residents of Saint Martin attach a high value to the storm protection provided by the lagoon, the water quality of the lagoon, as well as to the habitat function for species in the lagoon. They attach no significant value to recreational opportunities on the lagoon, or to the number of stay-over tourists on Saint Martin.

Importance for non-residents

Besides the value that the lagoon provides to the local population, the lagoon also provides important benefits related to tourism, fisheries, and carbon sequestration. The poor water quality of the lagoon directly impacts the quality of the nearby beaches and coral reefs, which are the main attractions for tourists on Saint Martin. Furthermore, the mangroves and seagrasses present in the lagoon store carbon dioxide and provide a nursery ground for many marine species. To estimate the tourism, fishery, and carbon sequestration value of the lagoon, a method called value transfer has been applied. This method utilizes economic value estimates from other study sites, and applies them to the Simpson Bay Lagoon. For the value transfer,

² A much more thorough explanation of the choice experiment, and its implementation on Saint Martin, can be found in the full report available on the EPIC website: <http://epicislands.org/publications.html>

conservative values have been assumed. This means that the presented economic value estimates are likely an underestimation of the true economic value of the lagoon.

Total Economic Value of different scenarios

Taking into account both resident and non-resident values allows for the estimation of the total economic value of the lagoon. Figure 6 shows that the current total economic value of the lagoon is almost US\$20 million per year. Currently, the lagoon is especially of high value for tourism, habitat for species, and storm protection. However, the economic value of the lagoon will drop to near zero if current pollution and degradation continues (business-as-usual scenario). The installation of a sewage treatment plant, on the other hand, would increase the yearly economic value to more than US\$30 million. A sewage treatment plant would strongly improve the water quality of the lagoon, which also has beneficial effects on tourism and habitat for species. Large-scale restoration of mangroves in the lagoon would increase the economic value to around US\$28 million per year. Mangroves provide important habitat for species and protect properties nearby the Lagoon against storm damage. In addition, mangroves have a water filtering function, which helps to improve the water quality of the lagoon.

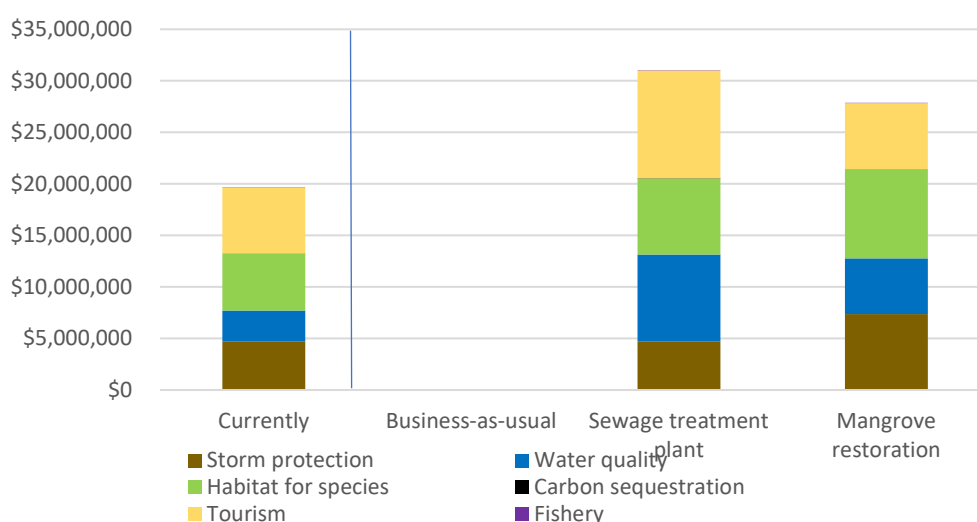


Figure 6 The total economic value of the lagoon under different management scenarios

4.2 Cost-benefit analysis of environmental management scenarios

Figure 7 shows how the yearly economic value of the lagoon changes over time for the three management scenarios. It clearly demonstrates that, compared to a business-as-usual scenario, the economic value of the lagoon will be much higher when installing a sewage treatment plant, or when conducting mangrove restoration. However, the construction and maintenance of a sewage treatment plant, and the restoration of mangroves are costly. The cost figures of both environmental management scenarios are presented in Figure 8. The costs of constructing and maintaining a sewage treatment plant are much higher than the costs of mangrove restoration.

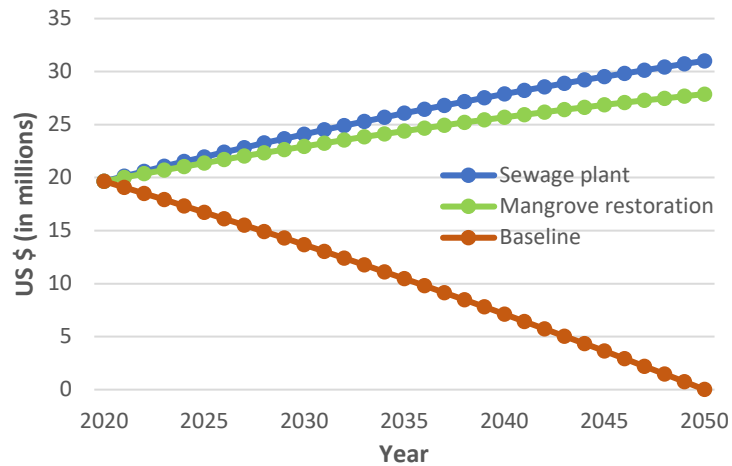


Figure 7 Yearly benefits of the environmental management scenarios

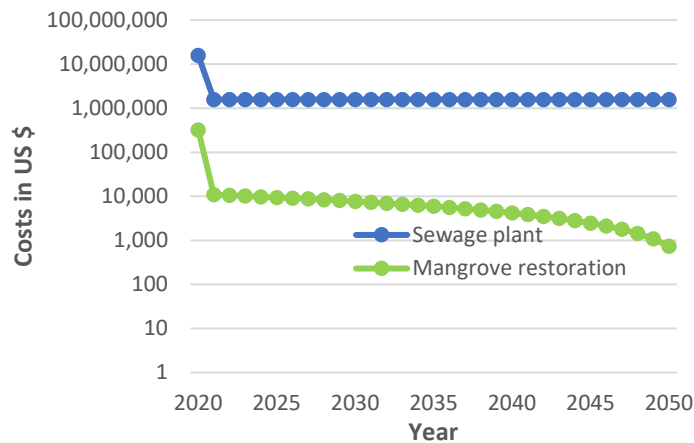


Figure 8 Yearly costs of the environmental management scenarios

In order to see if the benefits of the environmental management scenarios outweigh their costs, the benefit-cost ratio (BCR) has been calculated. The BCR shows if and to what extent the added benefits of the environmental management scenarios outweigh their costs. If the BCR is higher than 1, the benefits exceed the costs.

Assuming a 3% discount rate, the BCR for constructing a sewage treatment plant is 6 and the BCR for mangrove restoration is 541. Hence, the results of this cost-benefit analysis demonstrate that the economic benefits of better environmental management of the lagoon, in the form of building a sewage treatment plant and/or mangrove restoration, strongly outweigh their costs. This especially holds for the mangrove restoration scenario. Consequently, opting for a business-as-usual scenario, therewith continuing current pollution levels, would work against the long-term economic welfare of Saint Martin.

5 Conclusion and policy recommendations

Currently, the Simpson Bay Lagoon in Saint Martin is threatened by pollution and degradation. This has detrimental impacts on the ecological integrity of the lagoon and on the local livelihoods that depend on the lagoon's provisioning of important ecosystem services. This policy brief has described and integrated the results of three novel studies on the environmental, societal, and economic relevance of the Simpson Bay Lagoon. The uniform conclusion of these three studies is straightforward: Better environmental management of the Simpson Bay Lagoon is indisputably beneficial from an ecological, societal, and economic perspective.

Results of the "Planet" study, which conducted a water quality analysis and a review of the most important pollution sources, have shown that the lagoon is currently very polluted, in particular with faecal matter. The poor water quality of the lagoon is an ongoing threat not only to the health of aquatic ecosystems but also to the health and well-being of Saint Martin's residents. Mangrove destruction, the absence of a sewage treatment plant, and the release of toxins from marina's and sunken boats are strongly contributing to this pollution.

The results of the "People" study indicate that people value the lagoon greatly. Elderly respondents that grew up on the island remembered the lagoon as a clean and beautiful place where they would go swimming and catch lobsters. Very few of this beauty is still remaining. The high value of the lagoon in combination with the high support for the proposed management options that were found in this research imply that the people of Saint Martin are ready for the implementation of the proposed measures to protect the lagoon. The study has also shown the high benefits of improved education and facilitating recreational opportunities for improving local people's environmental attitudes and behaviour.

The "Profit" study, in which an economic analysis was conducted, clearly reveals the high economic importance of the lagoon for the residents of Saint Martin. If pollution continues at current levels (business-as-usual scenario), the economic value of the Simpson Bay Lagoon will soon be lost. Mangrove restoration and the installation of a sewage treatment plant would be able to maintain and even increase the economic value of the lagoon, mainly due to its positive impact on human well-being and tourism income. The cost-benefit analysis has shown that the added benefits of these two environmental management scenarios strongly outweigh their costs. Doing nothing therefore makes no economic sense.

All studies have shown that the rehabilitation of the lagoon's ecosystem through mangrove restoration and/or the construction of a sewage treatment plant would greatly improve the livelihoods of many people on Saint Martin. Hence, decision makers from both the Dutch and the French side of Saint Martin should overcome their disagreements and work together to implement these environmental measures. However, these two environmental management scenarios that were included in the cost-benefit analysis are not standalone measures. A proper mooring system should also be put in place, such that anchoring boats cannot destroy the seagrass habitats in the lagoon. Furthermore, the dumping of wastewater in the lagoon by boats should be prohibited, and to facilitate this, sufficient facilities such as pump-out services should be provided. Dangerous chemical products, prohibited by international law, should also be strictly banned for sale in Saint Martin. In addition, more effort should be put in the removal of sunken boats in the lagoon. Finally, for all these measures to succeed, stronger enforcement of environmental regulations is needed on Saint Martin.

All in all, the reputation of the lagoon as a free haven and dumping location should shift towards that of a pristine and precious environment that must be protected. The results of the three studies signify that if local decision makers would genuinely care about the long-term economic, environmental, and social wellbeing of Saint Martin, proper environmental management of the Simpson Bay Lagoon should be put into place rather sooner than later.