IVM Institute for Environmental Studies

Mapping the Economic Value of Ecosystems on Saba

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Contents

List of abbreviations 5

Summary 7

1 Introduction 9

2 Methodology 11
  2.1 Mapping ecosystem services 11
  2.2 Base maps 11

3 Ecosystem service values 15
  3.1 Carbon sequestration 15
  3.2 Cultural and local recreational value 16
  3.3 Tourism value 18

4 Total economic value 21
  4.1 The TEV map 21
  4.2 Analysis 22

5 Conclusion 26

Acknowledgements 27

References 29
List of abbreviations

CPV  Coastal Protection Value
CT   Cruise Tourists
FPA  Fisheries Protected Areas
GDP  Gross Domestic Product
NPV  Net Present Value
SOR  State of the Reef
SOT  Stay-over Tourists
TEV  Total Economic Value
WTP  Willingness to Pay
Summary

This report will specifically focus on the spatial distribution of the ecosystem values and eventually visualize these values geographically in a total economic value map. The total economic value (TEV) of the ecosystems of Saba is the sum of several different and mutually exclusive economic values. All these values have been previously studied and are published in different reports (Cado van der Lely et al. 2014; Dekker et al. 2014; Van de Kerkhof et al. 2014). In this report we will merely visualize these values geographically and add up the values to create the TEV map. The TEV map will then be used to assess whether current spatial planning covers those ecosystems which are most valuable to the economy of Saba.

The TEV map has clearly demonstrated that for the marine and the terrestrial ecosystems of Saba, the economic value is highly concentrated on relatively small areas. On the island the economic value is mostly concentrated on the slopes of Mount Scenery. This value can for a large part be attributed to what tourist spend and are willing to pay for a vacation enjoying the natural beauty of trails around Mount Scenery. The marine value can almost solely be attributed to the coral reefs of the coastal waters of Saba.

Although, there are several policies in place to manage the areas with high economic value on the terrestrial grounds of Saba, there is no authority that is in charge and responsible for the conservation of certain economically valuable natural areas. To guarantee the sustainability of the concentrated economic value on Mount Scenery, the management of this area could be more sufficiently embedded within the institutional framework of local spatial policy.

The current zoning of the Saba marine park is concurrent with the spatial distribution of economic value. However, some reefs which add a significant value to the economy of Saba are located within the less protective zoning of 'Multipurpose'. A light alteration to the zoning including this area in the 'no take' zoning could provide optimal protection of the coral reef and thus retain the economic value of the marine park.
1 Introduction

The project ‘What is Saba’s Nature Worth?’ aims to provide a socio-economic valuation of Saba’s natural environment. The framework of this project is based on the valuation of different ecosystem services. Ecosystem services are defined as goods and services that humans derive from ecosystems, either directly or indirectly (Costanza et al. 1997). Direct values, also known as use values, are the values of goods directly used by humans. On Saba one can think of the coral reefs that provide leisure in the form of diving, or forests that provide a beautiful environment for adventurous hiking. Indirect values are less tangible and are defined as the value assigned to the environment but the ecosystem services is not directly used. Examples are the value humans attach to an ecosystem merely for its existence.

This report will specifically focus on the spatial distribution of the ecosystem values and eventually visualize these values geographically in a total economic value map. The total economic value (TEV) of the ecosystems of Saba is the sum of several different and mutually exclusive economic values. All these values have been previously studied and are published in different reports (Cado van der Lely et al. 2014; Dekker et al. 2014; Van de Kerkhof et al. 2014). In this report we will merely visualize these values geographically and add up the values to create the TEV map. The TEV map will then be used to assess whether current spatial planning covers those ecosystems which are most valuable to the economy of Saba.

Like on most Caribbean islands the economy of Saba relies on international nature-related tourism. Therefore, the most important ecosystem service value is the use-value for nature-related tourism. One can think of hiking trails around Mt Scenery where tourists can enjoy the elfin forests, or the coral reefs, enjoyed by a vast number of divers. The cultural and recreational natural values experienced by tourists is derived through an extensive tourist survey (cf. Van de Kerkhof et al. 2014). Similar to this tourism value we will also map the value of local cultural and recreational ecosystem services. A study has been conducted to measure the valuation of local inhabitants’ households for the local cultural and recreational value of the ecosystems of Saba. The results of this study are discussed in Dekker et al. (2014).

Other economic values of the island’s nature are more supply-orientated. An important ecosystem service of tropical forests and coral reefs is carbon sequestration. One hectare of tropical forest is estimated to have the capacity to store up to 21t of carbon per year. Since a substantial part of Saba is covered with forest, there is a considerable carbon sequestration capacity (Cado van der Lely et al. 2014). Coral reefs also have this ability, it being to a much lesser extent than tropical forests.

Commercial fisheries in Saba take place mainly on the Saba Bank, the largest atoll of the Caribbean and located just a few kilometres south west of Saba. Fishery in the marine park around Saba is limited to a small number of recreational fishermen. Since we focus specifically on Saba and its surrounding marine park we will not include the value of fisheries in the TEV map.

All different ecosystem services that will be included in the eventual TEV are presented in Table 1, together with the corresponding report.
Table 1  Overview of TEEB reports on Saba

<table>
<thead>
<tr>
<th>Ecosystem Service</th>
<th>Report</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Tourism</td>
<td>Van de Kerkhof et al. (2014)</td>
</tr>
<tr>
<td>2. Local Culture and Recreation</td>
<td>Dekker et al. (2014)</td>
</tr>
<tr>
<td>3. Carbon Sequestration</td>
<td>Cado van der Lely et al. (in press)</td>
</tr>
</tbody>
</table>

After a brief reflection on the use of value maps in the field of ecosystem service valuation, we will provide a value map for each of the above ecosystem services, accompanied by a short description on the values. In chapter three we will provide the TEV map and compare our outcomes with existing spatial management policies to find out whether current policies are efficient in conserving the most valuable parts of the ecosystems on Saba.
2 Methodology

2.1 Mapping ecosystem services

Increasingly, the value of ecosystems is being linked with specific biophysical characteristics of geographical regions to be able to allocate economic value of ecosystem services spatially (Troy and Wilson 2006). The use of Geographical Information Systems (GIS) has gained popularity in ecosystem valuation studies since the 1990s (Eade and Moran 1996). In the past 20 years more than a hundred peer reviewed studies were published using GIS tools to spatially allocate economic value of ecosystem service value (for an overview see Crossman et al. 2013). Due to the inherent spatial character of ecosystem services, mapping their distributions can visualize and simplify complex structures which otherwise could be neglected (Burkhard et al. 2012). Its mapping is therefore regarded as vital to successful implementation of the concept of ecosystem services into local policies and spatial planning (Burkhard et al. 2012).

However, a standardized fashion of mapping ecosystem services value is yet to be developed and many different surrogate techniques are being used to translate ecosystem service values to spatial entities (Egoh et al. 2008). Many times data are unavailable so surrogate methods should be applied to reveal the economic importance of ecosystem services. A frequently used technique to omit the problem of a lack of data is so-called spatial value transferring, where data acquired on other sites are transferred to the study site.

Despite these uncertainties and validity issues, spatial data on Ecosystem Service Value (ESV) should be presented in a map to indicate geographical relations. However, as Harley (2009) points out: “[..] maps cease to be primarily understood as inert records of morphological landscapes or passive reflections of the world of objects, but are regarded as refracted images contributing to dialogue in a socially constructed world” (2009, p. 277). Thematic maps can be very valuable for both researchers and policymaker, but are never value-free (Dodge et al. 2008). Especially in the case of ESVs, where a lot of surrogating and value transfer takes place, the entrance of subjective values is inevitable, while a map still implies a certain objectiveness to most readers as a mere communication of spatial data (Crampton 2001). In this study we will therefore try to be as clear as possible on the methods and techniques used to create the ecosystem service value maps. The value maps have the potential to be of vital importance to successful policy making and spatial planning, but should always be interpreted correctly and not be taken as a perfect value-free visualization of reality.

2.2 Base maps

The most common way to map ecosystem services is by using vegetation cover maps (Crossman et al. 2013). For this study we have used two different vegetation cover maps to base the apportionment of economic value on. The data on vegetation land cover is derived from a Worldview-2 Satellite Image acquired on February 18, 2011 (Smith et al. 2013). We have processed the image file in ArcGIS to obtain a raster image with pixels of 10 meter by 10 meter to optimally suit our objectives of distinguishing between different land use types. Figure 1 shows the raster image processed in ArcGIS. Regrettably clouds were covering some parts of Saba on the 19th of February 2011. No data is available for the land covered by the clouds. In our analyses we have extrapolated data from comparable land to estimate the land cover in the cloud-covered areas.
Figure 1 Satellite Image Saba (Smith et al. 2013)

More qualitative data is acquired from a local vegetation map by de Freitas et al. (2012). This landscape-based vegetation map is an updated version of Stoffers’ map of Saba of 1956, with field data acquired in 1999. The accompanying report gives extensive information on the used types of vegetation categories (de Freitas et al. 2012). Figure 2 presents de Freitas’ vegetation map slightly edited for our purposes.

The different habitats in the marine environment of Saba (i.e. the national marine park surrounding the island) was recently mapped by IMARES. We have used these maps for the appropriation of the marine ecosystem values (Meesters et al. in prep.). Figure 3 displays the IMARES marine habitat zonation.
Figure 2  Vegetation map Saba (De Freitas, 2012)
Figure 3 Marine Zonation (Meesters et al. in prep)
3 Ecosystem service values

3.1 Carbon sequestration

Climate change can be buffered via carbon sequestration (De Groot et al. 2010), CO2 gets fixated, removing a greenhouse gas from the atmosphere. Carbon sequestration plays a role in temperature and precipitation both at the local and global scale (Costanza et al. 1997). Both forest and coral reefs are ecosystems which have the ability to sequestrate carbon.

Van Beukering et al. (2013) determined the ecosystems involved in carbon sequestration on Bonaire. From these ecosystems only coral reefs and forest apply for Saba. In this report we used the same average carbon fixation rate as was used in the Bonaire case. A market based approach was taken to value carbon sequestration. There is a carbon market in place and trading the average worldwide market price for a tonne carbon was US $13.80 in 2012.

Dry forests sequestrate on average 21 tonnes of carbon per hectare per year. On Saba about 1,300 hectares can be regarded as dry forest meaning that its carbon sequestration capacity is estimated at 27 thousand tons per year. We have used the average carbon value of $13.80 per tonne to calculate the yearly value of carbon sequestration of US $376,740.00 for the terrestrial vegetation. The reefs can sequestrate carbon to a lot lesser extent. We have used the value of 1.06 tonnes per year for one hectare of coral. This leads to an annual value of $ 4,512.73.

Table 2 Economic value of Carbon sequestration

<table>
<thead>
<tr>
<th></th>
<th>Terrestrial</th>
<th>Marine</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total</td>
<td>$ 376,740.00</td>
<td>$ 4,512.73</td>
</tr>
<tr>
<td>Total per hectare</td>
<td>$288.14</td>
<td>$ 5.56</td>
</tr>
</tbody>
</table>

To allocate the economic value of carbon sequestration across Saba, we have used both the vegetation map of de Freitas (2012) and a coded satellite image to identify the percentage of forest in each vegetation area. Using the raster vegetation cover map we calculated per vegetation what percentage was covered with forest.

Figure 4 shows the spatial allocation of the value of carbon sequestration. By far the highest value for carbon sequestration is located on the northern slopes of Mount Scenery. The lower southern slopes have relatively less forest and are therefore less capable of sequestrating carbon. Only some carbon is sequestrated by the corals around Saba. On average the reefs sequestrate carbon for a value of just less than $15 per year per hectare.
3.2 Cultural and local recreational value

The local recreational and cultural value of the natural environment of Saba was derived by conducting a survey among local households on the island (Dekker et al. 2014). This study applies a recent innovation in stated preference methodology, the choice modelling (CM) method, for assessing the willingness to pay (WTP) of Saban residents for the protection and conservation of their natural environment. In CM respondents are asked to choose between different scenarios which are built with a set of attributes. By having a payment vehicle, like a fee as one of these attributes, the monetary values of each attribute can be indirectly derived. Respondents’ choices between the scenarios reflect the trade-offs they are willing to make between different levels of these attributes, and ultimately lead to the values they assign to the ecosystems.
CM indirectly measures the WTP for conservation of respondents through an experiment as described above. The local household study created a choice model to reflect both marine and terrestrial ecosystems. The management of the archaeological heritage on Saba is also taken into account. The attributes were chosen based on a stakeholder consultation approach. The most important ones were considered to be the quality of coastal waters, landscape quality, management of archaeology and livestock. A team of interviewers conducted surveys among 300 households, applying the CE and a supporting qualitative questionnaire.

Analysis of the survey shows that the annual willingness to pay to improve the overall natural environments by all households on Saba is approximately 150,000 USD per year. Several trends emerged, the most important being that 60% of respondents indicated that they are in principle willing to pay for protection of the natural environment. For households that opted out, the most common reasons were that they were not able to afford the fees and a lack of confidence that any money collected for ecosystem conservation will be used effectively. From the total willingness-to-pay by residents of Saba more than 30,000 USD per year was for the conservation of the terrestrial environment and almost 38,000 USD per year for the marine environment. See Dekker et al. (2014) for more information on the WTP by residents of Saba.

Table 3: Value of the ecosystem for cultural and local recreation

<table>
<thead>
<tr>
<th></th>
<th>Terrestrial</th>
<th>Marine</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total</td>
<td>$30,825.67</td>
<td>$37,887.74</td>
</tr>
<tr>
<td>Total per hectare</td>
<td>$23.58</td>
<td>$46.70</td>
</tr>
</tbody>
</table>

In Figure 5 the economic value of local households for the natural environment of Saba is spatially distributed over both the terrestrial and marine ecosystems of the island. The annual WTP for the quality of the coastal waters was equally distributed among the coastal waters surrounding Saba. The WTP for the quality of the terrestrial environment was allocated similar to how the carbon sequestration value was distributed. Since there was no information on the spatial distribution of the terrestrial value we have assumed that the WTP for natural terrestrial quality can be assigned to the forests, the most important ecosystem of the island. Therefore the local cultural and recreational value for the terrestrial environment was allocated only to areas covered with forest.

The 30,000 USD per year for terrestrial ecosystems was distributed across the 1,300 ha of tree-covered land on Saba. Each region from the vegetation map received a relative part of this value corresponding to their tree coverage. Similarly to the carbon sequestration value, the local cultural and recreational value concentrates around Mount Scenery, where most land is covered with forest.
3.3 Tourism value

By far the most important value natural environment on Saba is derived from the tourism value. Although only 22,500 tourist visit the island per year, the tourism economic value of ecosystems is enormous compared to the other local values computed in this study. A tourist exit survey has been conducted to estimate the consumer and producer surplus and the dependence of these values on the nature of Saba. The study has identified the activities in which tourists participate while visiting Saba, and quantifies the benefits that are created through these activities for the tourism industry. By estimating the dependence of the activities on the ecosystems of Saba the importance of nature for the tourism industry is estimated. The study then uses spatial data to determine which ecosystems have the highest economic value with regards to tourism.
The tourist exit survey is also used to investigate the expenditures of tourists visiting Saba, as well as their willingness to pay (WTP) for protection of nature on the island. This clarifies tourists’ perceived value of different aspects of the natural environment.

Using a choice experiment as a valuation tool, the study estimates the impact of changes in the natural environment on Saba to the consumer surplus (CS) of the tourist industry. Revenue is estimated through the responses about tourist expenses that were collected in the survey. In the study, the annual value of nature for the tourism industry is calculated.

The study of Van de Kerkhof et al. 2014, estimated that the 22,500 visitors spent approximately 30 million USD annually on Saba. It is estimated that around 70% of these revenues are depending on ecosystem services. A total annual value of approximately 7.5 million USD dollar is calculated for the marine and terrestrial ecosystems. Of the estimated added value that is created in the tourism industry, more than 5 million USD is attributable to the natural environment. The study estimates that visitors are willing to contribute almost 1.6 million USD to maintain the natural beauty of the “Unspoiled Queen”. This supports the hypothesis that natural capital is crucial for the tourism industry on Saba.

Table 4 Tourism value of the terrestrial and marine ecosystems

<table>
<thead>
<tr>
<th></th>
<th>Terrestrial</th>
<th>Marine</th>
</tr>
</thead>
<tbody>
<tr>
<td>Producer Surplus</td>
<td>$2,469,386.25</td>
<td>$3,528,393.75</td>
</tr>
<tr>
<td>Consumer Surplus</td>
<td>$764,000</td>
<td>$818,000</td>
</tr>
<tr>
<td>Total</td>
<td>$3,233,386.25</td>
<td>$4,346,393.00</td>
</tr>
<tr>
<td>Total per hectare</td>
<td>$2,472.95</td>
<td>$5,359.30</td>
</tr>
</tbody>
</table>

The tourism value that can be attributed to the marine environment was spatially allocated using the location of the dive spots along the coral reefs surrounding Saba. Corresponding to the yearly divers of each dive spot, the value was assigned over these spots. A buffer with a radius of 300 meters was drawn around each dive spot. A habitat that intersects with a buffer gets the value of the corresponding dive spot.

The terrestrial tourism value is allocated using the other popular touristic attraction: hiking. Very few tourists visit Saba without hiking at least once along one of the hiking trails. The hiking trails are the prime opportunity for tourist to enjoy the natural environment of Saba. Therefore, the environments along the hiking trails are the parts enjoyed by tourists. The value was allocated along all hiking trails, taking into account the popularity of each trail. A buffer with a radius of 200 meter around the trails was created to distribute the values amongst the habitats. Moreover, tourists have indicated they visited the beach as well. Since the beach can be regarded as an ecosystem as well, part of the value is also allocated to the two beaches of Saba. To appropriate the value between the trails and the two beaches we have used the tourism survey that was conducted by Van de Kerkhof et al. (2014). The survey revealed which part of the tourists has visited both the individual trails as well as the beaches. Each beach or trail received the relative size of the value corresponding to the number of tourists visited the beach or trail divided by the total number of beach visits and trail hiking (both variables are measured as a dummy for each tourist: either visited the beach/trail or not).
Especially, the marine value is very concentrated in just a few small areas. A few dive spots on the west are very popular among divers; parts of the reef have been estimated to return a value of over 200,000 USD per year per hectare. Clearly most tourists dive around the area highlighted in blue on Figure 6.

The terrestrial value is concentrated around the higher areas of Mount Scenery. The concentration around the mountain top is not very surprising since previous maps have shown that most natural habitats are concentrated in this area. Moreover, most popular hiking trails are along the mountain as well. Both Cove beach and Well’s Bay have the highest value per hectare, exceeding 30,000 USD per year. However, the beach only covers a small area, smaller than one hectare.

**Figure 6**  **Spatial allocation of the tourism value**
4 Total economic value

All values in the maps produced for this study can be summed to one single map representing the total economic value of the natural environment of Saba. For the total economic value (TEV) map the vegetation map of de Freitas is used and the marine map of IMARES. Although the TEV map encompasses a lot more than the touristic value, the two maps are very similar, once again proving that the most important ecosystem service of Saba is value for tourists. Table 5 shows the sum of all different values mapped in this report.

<table>
<thead>
<tr>
<th>Carbon sequestration</th>
<th>Terrestrial</th>
<th>$376,740.00</th>
<th>$288.14</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Marine</td>
<td>$4,512.73</td>
<td>$5.56</td>
</tr>
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<td>Local cultural and recreational value</td>
<td>Terrestrial</td>
<td>$30,825.67</td>
<td>$23.58</td>
</tr>
<tr>
<td></td>
<td>Marine</td>
<td>$37,887.74</td>
<td>$46.72</td>
</tr>
<tr>
<td>Tourism</td>
<td>Terrestrial</td>
<td>$3,233,386.25</td>
<td>$2,472.95</td>
</tr>
<tr>
<td></td>
<td>Marine</td>
<td>$4,346,393.75</td>
<td>$5,359.30</td>
</tr>
<tr>
<td>Total</td>
<td>Terrestrial</td>
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<td>$2,784.67</td>
</tr>
<tr>
<td></td>
<td>Marine</td>
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<td>$5,411.58</td>
</tr>
<tr>
<td></td>
<td>Total</td>
<td>$8,029,746.14</td>
<td>$3,790.30</td>
</tr>
</tbody>
</table>

4.1 The TEV map

Using an overlay tool with ArcGIS, we have allocated all values per habitat to create a map showing the total economic value per region. All values per hectare per year are visualized in Figure 7. As could have been expected, there is a sharp contrast in values both on the terrestrial as well as on the marine surface. The greatest economic value of the Saban natural environment can be found on and along Mount Scenery and the beaches on Well’s Bay and Cove Bay near the airport. The values on the top of Mount Scenery can rise up to almost 20,000 USD per hectare per year. Although going to the beach is not the prime reason of tourists to visit Saba (Van de Kerkhof et al. 2014), they do make use of these ecosystems and considering residential recreational activities, conservation of these ecosystems should have high priority on Saba.

The marine value clearly concentrates west from the shoreline of the island. On some point of this area values can even exceed 200,000 USD per hectare per year. The conclusion is pretty straightforward that this area of coral reef is immensely important to the economy of Saba and should be maintained in the best condition at all costs.
However, it should be noted that the corals around Saba are functioning as one big organism, and different areas of reef are interlinked to each other. Although there are not many dive spots on the eastern side of the island, and hence no significant economic value can be found here, management should focus on these areas as well since a decrease in quality on the less valuable side can have enormous impacts on the valuable side of the coral.

**Figure 7** Total economic value map of Saba

### 4.2 Analysis

In this section we will analyse to what extent current policies, enacted to preserve the natural environment, comply with spatial allocation of value as described in this report. We are looking whether the areas with high economic value attached to are also those regions which are protected by local policy.
Terrestrial

Saba has one terrestrial natural park which is managed by the Saba Conservation Foundation. This park is situated in the north of Saba and largely consists of the area along the Sulphur Mine Hiking Trail. In addition, Saba has a no construction policy for areas elevated more than 550 meters above sea level. This area consists of the top of Mount Scenery. However, this area is not managed by a single authority and is owned by many different private entities. Figure 8 presents the location of both the national park and the zone above 550 meters.

The national park was enacted since this area contains most unique features of Saba such as flora and fauna species. However, the economic value calculated in this study is not located within the perimeter of the national park. The lion’s part of the economic value can be attributed to the area situated 550 meters above sea level.

Figure 8  Total economic terrestrial value map of Saba including the boundaries of the terrestrial protected areas
Since the total value of the 550 meters zone exceeds 1 million USD per year, it can be considered as the most important terrestrial natural asset of the island. Conserving the natural environment and maintaining its value should therefore have top priority. Currently there is, however, no zoning or comprehensive planning policy. Unequivocal responsibility for the conservation of the natural capital on Mount Scenery is currently not existing.

To guarantee the conservation of the natural environment on Mount Scenery and retain its natural economic value, we recommend appointing an appropriate entity responsible for the conservation of the area above 550 meters and simultaneously has the authority to impose regulation on the usage and alterations of the area.

Marine

Contrary to the terrestrial policy, the Saba Conservation Foundation (SCF) has a zoning plan for the marine park around Saba. SCF has identified four different zoning designations to preserve the natural beauty of the coastal ecosystem. There are several ‘no take’ zones which are designated to preserve the reefs within these zones. No fishing is allowed in these zones. Less restrictive are the mooring zones where yachts can moor, the recreational zone, where swimming, snorkelling, diving and sailing can exist next to each other and one multi-purpose zone where both fishing and diving are allowed.

Figure 9 reveals that the mooring zones are located in areas where damage to coral reef is minimized. Moreover, the recreational zone is located outside valuable areas so damage to the economic value by recreation in this zone is also minimized. The no take zones are located around the most valuable assets of the marine park of Saba and mostly consist of coral reefs of various types.

According to the economic value of the different areas of the marine park we would advise to establish one more no take zone on the south of the marine park at Great Level Bay to ensure that the economic value of the reefs is optimally preserved. In this area around 180,000 USD of the total economic value of the marine value can be attributed to the area south of Great Level Bay.
Figure 9  Total economic marine value map of Saba including the marine protected areas
5 Conclusion

In this study the total economic value of Saba's natural environment has been attributed to different (parts of) ecosystems. Value maps are created for the most important ecosystems services. Together, these maps are combined to form the TEV map of Saba. The TEV map has clearly demonstrated that for the marine and the terrestrial ecosystems of Saba, the economic value is highly concentrated on relatively small areas. On the island the economic value is mostly concentrated on the slopes of Mount Scenery. This value can for a large part be attributed to what tourist spend and are willing to pay for a vacation enjoying the natural beauty of trails around Mount Scenery. The marine value can almost solely be attributed to the coral reefs of the coastal waters of Saba. Diving is the most important activity of international tourist visiting Saba and a lot of their spending and their willingness to pay can be attributed to the coral reefs. Especially the coral reefs on the west of the island showed high economic value.

Although there are several policies in place to manage the areas with high economic value on the terrestrial grounds of Saba, there is no unequivocal authority that is both in charge and responsible for the conservation of the natural environment. To guarantee the sustainability of the concentrated economic value on Mount Scenery, the management of this area should be sufficiently embedded within the institutional framework of spatial policy.

The current zoning of the Saba marine park is concurrent with the spatial distribution of economic value. However, some reefs which add a significant value to the economy of Saba are located within the less protective zoning of 'Multipurpose'. A light alteration to the zoning including this area in the 'no take' zoning could provide optimal protection of the coral reef and thus the economic value of the marine park.
Acknowledgements

This study would not have been possible without the support of numerous people and organizations on Saba. It was great to start our visit with a discussion with the Executive Council, government officials of the Saba government and employees of SCF. We would like to express our gratitude to governor Jonathan Johnson and the Executive Council for their hospitality and the time mister Johnson took to share his vision.

Moreover, we like to thank all the people who attended the workshop on valuing the natural environment of Saba and others who gave us valuable information on Saba; especially Kai Wulf, James Johnsson, Johan Scheaffer (SCF), Glenn Holm (Saba Tourist Bureau), Vito Charles, Lynn Costenaro (Sea Saba), Cherie van Wyke & Tony Waterfield (Saba Deep), Tommy Wescott (airport), Tom van ‘t Hof and Will Johnson and many others, we thank you for your expert opinion and the data you provided. Your contribution was crucial for the success of this study.

This study could not be possible without the help of our interview team on Saba: Kathy Samuel, Samar Ghazi, Jenna MacDonald and Fred Bower.

IMARES was of great assistance and provided us with local data and model suggestions to further improve this research. Thank you Ingrid van Beek, Bert Brinkman, Martin de Graaf and Erik Meesters for your expertise and discussions.

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References


Dekker, B., P. Van Beukering, S. Schep and E. Wolfs. 2014. Recreational and cultural value of saba's nature to its inhabitants. VU University of Amsterdam.


