

EXECUTIVE SUMMARY

The Role of Economic Valuation in Developing Adaptation Policy to Climate Change in the Caribbean.

The island nations of the Caribbean have a strong dependency on their natural resources. Their coastal zones are particularly valuable, with their beaches and coral reefs providing important revenues in the form of tourism activities, as well as providing their local population with recreational and cultural value, and their mangroves being a source for subsistence livelihood and replenishment of their fisheries. These key natural resources are also particularly vulnerable to climate change impacts, and are the key link in understanding the economic potential for damage that climate related events can bring.

The process of planning for mitigating these climate related impacts requires a careful consideration of the consequences of action and non-action. Being able to develop estimates of the comparative costs of action and non-action is an important tool in deciding whether to take action, and what kind of action is more appropriate, or even feasible. For this reason, it becomes important to develop and apply non-traditional economic tools for valuating the impacts of natural events along with estimating the costs of the actions required to mitigate these impacts.

This report explores the application of several of these non-traditional economic tools for estimating the costs of potential impacts of climate change and sea level rise in the Caribbean nations of Trinidad & Tobago, St. Lucia, and Dominica. The economic tools that are explored use several types of direct and indirect approaches, and both market and non-market values are considered. These approaches have been developed with the express interest in their replicability in other Caribbean nations and island nations around the world.

One of these non-traditional approaches is the use of related markets to value environmental impacts on key economic sectors, such as tourism and fisheries, in economic terms. In this study, the change in tourism expenditures in St Lucia along a period of several years is used to measure the economic impacts of hurricanes, events which are predicted to increase in frequency due to climate change. Through measuring the extent of economic loss and tying it to specific attributes such as infrastructure for tourism that have experienced climate-related damage, it becomes possible to measure the potential economic damage that may be caused by climate change, and direct efforts for mitigation toward those attributes that are deemed vulnerable. Another possibility is to link effects on ecosystems to decreases in productivity values. In this instance, a decrease in the productivity of shrimp fisheries (using the shrimp catch as a proxy) is related to the decrease in the area of neighboring mangroves in Trinidad, a coastal ecosystem highly vulnerable to climate change.

The value of climate impacts on local recreational activities can be estimated by using related activities whose cost can be measured. The study estimates the economic value of the recreational use of beaches in St. Lucia by its residents, and the potential impact of

climate change on these activities is valued through the simulated affectation of beaches, the vulnerable attribute. The related activity that is used for measurement of economic value of recreation is the comparative cost of transportation to these beaches. The measure of economic impact in this case is the change in cumulative welfare through the increase in costs incurred in modifying visitation patterns to the beaches, due to the loss of a subset of these beaches through climate change impacts.

The value of climate impacts on cultural resources and activities can also be estimated, and this is demonstrated through the measurement of the economic value of a cultural/aesthetic attribute, which has a non-use value as well as a use value, that is endangered by climate change. In this instance, the example is a religious temple in Trinidad, and the value of the services the temple provides is captured through direct questioning of the population on their willingness to pay for its preservation. This approach captures the economic value of an attribute by defining a hypothetical (contingent) market for it, in the absence of an actual market.

Following is a description of the techniques that were applied for measuring the economic impact of climate change on different sectors of the economy, as well as on cultural and recreational activities. For details concerning the studies that were conducted, please refer to the individual chapters of the report.

Measuring climate impacts on key sectors by using related markets.

Valuation of climate change impacts on the tourism sector.

In several cases, linking climate change impacts to losses in specific sectors depends, in the first place, on finding an indicator of economic loss and, in the second place, on linking the losses to damage to infrastructure. Data on changes in tourism expenditures due to climate events can be used as a crude measure of the economic damage they do. In order to obtain data on tourism expenditures, the study examines the impact of Hurricanes Allen, David, and Lenny on the number of visitors arriving in Saint Lucia. The data on the numbers of visitors between 1977 and 1982 show an upward trend for two different categories, cruise ship and stopover visitors. When compared across the years, the post-hurricane years show either a decrease or a leveling off. The number of visitor arrivals is then converted into number of visitation days. Hurricane Allen had a significant effect on the number of visitation days for both categories, David and Lenny affected mainly the number of stopover days.

Converting lost visitation days into monetary figures by using an estimated average visitor expenditure per day showed the effect of the hurricanes to be substantial: it is estimated that Hurricane Allen caused losses of over US\$1 billion.

The major loss in income was from stopover visitors: tourism infrastructure for stopover visitors (in the form of hotels) was damaged by the storms, while the infrastructure required for day trippers (in the form of docks) was not affected as badly. Compared to

Dominica, which is mainly an ecotourism attraction, Saint Lucia, as a beach destination, is comparatively vulnerable to climate events, through the direct damage to its beaches. Conversely, this suggests that Dominica should protect its ecotourism qualities, as this enhances the resilience of its tourism market and, by extrapolation, its economy.

Measuring climate impact on the fisheries sector.

The loss of infrastructure is also used for the economic valuation of climate impacts in the fisheries sector. If a hurricane destroys fishing vessels, gear and equipment, then the expenditures by individual firms to replace losses in equipment represent a minimum expected net value of the fishing operation. These expenditures represent lost capital, and the cost of replacing the capital represents the lower bound of economic damage of the climate event. Additional economic damage would come from the fact that capital was destroyed and not replaced. It is no longer available to perform a function, and consequently there is a loss of the income associated with it. In this case, not enough data were available on the expected earnings from the fisheries to be able to estimate the additional economic cost.

Another way to value the economic impact of climate change is indirectly, by relating ecosystem changes to losses in markets that depend on the ecosystem. This is illustrated in the report by using the value of fisheries dependent on wetlands in Trinidad in order to obtain a value for the wetlands themselves.

The reason fisheries depend on wetlands is that the latter function as hatcheries and nurseries for the larval stages of many commercial species. By correlating the yield of one these species, shrimp, with the area of the nearby wetlands over time, the value of the shrimp catch is transferred on to the value of the wetlands.

The size of the shrimp catch is related to shrimp production, as there is a point above which the amount of fish caught affects the size of the following year's catch; that is, shrimp is being fished unsustainably. Over a period of five years (1995-1996), the shrimp catch showed a marked decline. On the assumption that the decrease in the shrimp catch would be related to a reduction in the area of the wetlands over this period, an effort was made to quantify the reduction. Using a different study that showed a 1% change in mangrove area resulting in a 2.8% reduction in the shrimp catch, the authors estimated the percentage by which the wetlands would have had to decrease in order for the shrimp catch to be reduced by 41%, according to the data obtained. The estimate was 2.9%, which was similar to the 2.3% reduction estimated subjectively by local inhabitants. The 2.3% figure was reached by averaging out the estimates made by local inhabitants over the number of years they had lived in the area. Using the shrimp catch data, the gross value of the catch lost because of the loss of wetland area was estimated to be about US\$9,115 a year.

This value estimate would be considered an indirect use value. However, the wetlands could be also have direct use and non-use values. Direct-use values would include food and biomass collection and recreational activities, and nonuse value would include

aesthetic appreciation of the wetlands by individuals. The estimation of direct-use values was performed through a survey intended to capture the uses the local inhabitants made of the wetlands. Through this survey, it was learned that the direct uses included making use of the wetlands for making a living, for obtaining household items, and for recreational opportunities.

The valuation of these uses was done through market valuation of the products and food items that were obtained from the wetlands, whether they were sold or consumed in place. The time invested in the collection of these products was valued at the unskilled labor rate for Trinidad and Tobago. Adding up the figures for value of products and labor invested in their collection provided the net rent from the wetland products.

Correlating the reduction in wetlands with the net yearly rent, a net loss of US\$1,751 per hectare of wetland per year was estimated, or an absolute net loss of US\$842,000 a year.

The results of this study show a significant linkage between the subsistence of the local population and the existence of the wetlands. The loss of wetland area and quality due to climate change could seriously affect the well-being of the inhabitants. In addition, there would be indirect effects down the line, as with the reduction in the shrimp catch described above.

Valuation of environmental impacts on land attributes such as property values and sea defenses.

Another way of measuring the economic effects of environmental impacts is estimating the value of the attributes of an area or good. In this case, the idea was to value the impact of climate by measuring the differences in market property value (the good) according to the location of the property with respect to the coast (the attribute).

Sea-level rise and climate-change impacts are expected to affect the price of waterfront property. In order to determine if that is the case, data were collected on parcel location through tax maps, and assessments of land property values were obtained from estate services and municipal sources. A regression was then performed of the distances to water vs the property values per square foot, and the results were analyzed for correlations.

The study found that there is a positive correlation between the value of a property and its distance from the water, up to a certain point: at the waterfront itself, the correlation becomes negative. That is, being on the water reduced the value of an average parcel by US\$2,000. The results implied that people value being close to water, but not on the water itself, because of the possibility of damage from beach erosion and storm effects. In this manner, the value of the potential damage from climate is captured in the form of market valuation of the attribute "distance from the waterfront."

Additionally, it is crucial to measure the effects of climate impacts on expenditures for the construction of defensive infrastructure. In general, the capital costs of investing in this type of infrastructure are too high for any individual parcel owner in low-income areas to incur for the protection of private property; but, given that the value of the total property behind the defensive structures tends to be much higher, companies and public institutions may be willing to pay for this “public good” structure. A measure of this willingness to pay provides information on the value of climate impacts, and this information is sometimes available by observing the history of investment in sea defenses.

Estimating the value of climate change impacts on the recreational, cultural, and aesthetic use of resources.

Obtaining non-market (recreational) use values through indirect valuation methods.

When services are available to the public free of charge, the market cannot be used to measure potential economic impacts on the services due to climate events, and indirect methods need to be applied. In this instance, the example is a study that was performed on the recreational value of beaches in Saint Lucia. Through telephone and on-site interviews, beach use preferences among Saint Lucia’s population were determined. Inputting the data collected on the distance, time, and mode of transportation invested in travel to a particular beach in a GIS system yields an estimate of the costs incurred in traveling to the beaches. The change in the cost to receive comparable utility is what is considered to be the value of the beach.

To model the effect of a climate change scenario where the use of beach is lost, a comparison is made between the expected utility from the available beaches before and after the loss of a subset of beaches. The result can be converted to the loss of aggregate economic welfare by the beach users. In general, some beach users will need to spend more time or income in visiting an alternative beach if the choices are less. Lower and upper boundaries on the potential costs incurred by the loss of a beach are estimated in this manner, where the impact of climate change on beach loss can be quantified in economic terms. For example, the annual economic loss of one particular beach was estimated to range from a lower bound of US\$1,000,000 to an upper bound of US\$1,250,000. These studies reflect the importance of capturing the value local inhabitants place on their resources for estimating real potential economic impact from climate events.

Non-use (aesthetic and cultural) and total value estimation.

Aside from use values, resources may have non-use values associated with them (values that arise even without using the resource). Since there are no related markets that can be used to estimate these values, other methods must be used. In this case, resource value needs to be obtained through direct questioning of individuals who place this value on the resource.

This report applies a method of this kind in attempting to quantify the loss of a Hindu temple site that is threatened by sea-level rise. The temple has use value arising from the use of the site for religious and spiritual activities, and non-use value in that there are individuals who are willing to pay to preserve the site for its cultural and aesthetic value, although they do not use it.

To obtain estimates of these values, an intercept survey of users and a random telephone survey were conducted. The intercept survey took place at the site itself. It was mainly meant to capture information from users of the site on the number of times they visited the site each year and the cost of travel. Amongst the more interesting results of the survey, the fact that many users visited the site on work days meant that the visit represented an opportunity cost in the form of the value of their wage rate to them, in addition to the travel costs they incurred. The use value of the temple was calculated by developing a regression model that factored in the number of trips to the temple, the cost of the trips, and the number of trips to other similar sites.

The random telephone survey was performed in order to obtain an overall picture of the visitation pattern of the population, and to capture the value placed on the temple by non-users. A significant proportion of the population (72%) turned out to be willing to contribute to its preservation directly, and an even higher proportion (98%) thought it important that it be preserved. The willingness to pay this value was estimated through a logit model applied to data collected from response to a yes or no answer given to a suggested amount. The logit model relates population variables such as income, age, and education to the probability of paying for the preservation of the temple.

The total value of the services the temple provides was then estimated by adding up the resulting use and non-use values, with the non-use value from the users of the temple obtained by subtracting the results of the telephone survey from the use value obtained through the regression model as described above.

Conclusions

Several approaches are available for estimating the economic value of potential climate change impacts. These approaches can be applied to estimate these impacts on key economic sectors such as tourism and fisheries, or on activities that have not traditionally been valued in economic terms, such as local recreational and cultural endeavors. These approaches take into consideration that entire economic sectors are dependent on structures and attributes that are vulnerable to climate change related events. Therefore, the valuation of climate impacts takes the form of an exercise in finding the links between activities and vulnerable structures, and among the activities themselves.

Many of these approaches are relatively low in cost, and depend on gathering information that will be available locally. This includes data on economic activity or expenditures, or surveys of local inhabitants. In many instances, incomplete or partial data can still be

useful to extrapolate measures of total economic value, and related economic activities can be used to place value on climate impacts on structures or attributes that do not have a market value.

Through capacity-building and hands-on experience, it should be possible to train local consultants in the application of these methods. Placing economic value on natural resources represents an additional incentive for preserving and managing those resources, at the same time it provides good guidance on directing policy choices in deciding where and how much to invest in climate change adaptation measures.