



**Users Manual
Coral Reef-Associated Fisheries Valuation Tool
World Resources Institute
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This document serves as a Users Manual for the Fisheries Component of the Coral Reef Valuation Tool. This Tool was developed at the World Resources Institute (WRI) with intended use throughout the Wider Caribbean. The purpose of the Tool is to serve as a guidebook and calculator: a way for policymakers, civil society or other interested parties to assess the value to their economies of goods and services provided by coral reefs and to aid in setting coastal management policies. To that end, we have developed a tool we hope to be flexible enough to accommodate the many different types of data necessary for valuing coral reefs, while simple enough to be implemented by those not intimately familiar with the economics of natural resource valuation.

The Tool, which is comprised of three individual spreadsheets, calculates the net benefits from fisheries and tourism values separately, then adds them together (optionally with shoreline protection values) to estimate use value from coral reef goods and services. The Tool is a guide to the implementation of the *Coral Reef Economic Valuation Methodology* found at <http://www.wri.org/project/valuation-caribbean-reefs>.

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Read Before Using the Tool

Macros Setting

The Tool uses Excel macros to perform calculations and assist in entering data. In order to use the Tool, please make sure that the security level on Excel is set to Medium or below. (To change this setting, open Microsoft Excel, and select “Options” from the Tools menu. Then select the “Security” tab and choose “Macro Security,” set the security to “Medium”). While some Microsoft Excel files could contain macros which pose a danger, the Valuation Tool will not harm your files or operating system.

Data Collection

Using the Valuation Tool will require collecting data on the fisheries and tourism sectors within your site, island, country or region. To get a sense of the data required, please see Appendix 1, “Data Needs for Fisheries Valuation”. Not all data are required to do a valuation as several options are available depending on the level of detail possible. For the commercial fisheries section, for example, data can be entered a) by landing site; b) for a sample of fisherman; or c) based on coral reef area and estimated reef fish productivity. In addition, one can do a partial valuation and save the results until more data are available. For instance, one could calculate the value from commercial fisheries, leaving sections on fish processing and local use of fisheries empty. These values could be filled in once additional data are available.

For the more data-intensive elements of the valuation – commercial fisheries catch, for instance – you may wish to collect and organize data in an external spreadsheet, and then import into the Tool when doing the final valuation. Cutting and pasting data into the Tool is discouraged as this may introduce errors. Instructions on how to import data can be found on the relevant pages of the Tool and manual.

Caution: Do not delete or otherwise alter the contents of “grayed – out” cells. This will introduce errors into the Tool.

Structure of the Tool

The Tool consists of two separate Microsoft Excel files – one for the fisheries valuation, and one for the tourism and recreation valuation.

Fisheries Component

The Fisheries component of the Tool allows for the valuation of coral reef-related services in four areas: (1) commercial fishing, (2) commercial fish processing and cleaning value added, (3) local non-commercial fishing, (4) and the multiplier impacts of fisheries-related sectors upon the overall economy. The first three areas each have a page allowing the user to input data as well as a page showing the economic analysis for that area. The fourth area can be estimated using standard default or user-defined multipliers. There is also a summary value page showing the total estimated value of coral reef associated fisheries. The Tool offers the option of exporting the results from the summary page to an external spreadsheet.

Tourism Component

The Tourism component of the Tool has detailed valuation calculations for Accommodations and Recreation (diving and snorkeling sections) as well as for Marine Park Revenue, Local Use, and other spending by tourists who visit because of the reef. In the Tourism tool, users may enter accommodations data by hotel or hotel type and can enter data on dive operations in aggregated or detailed form. The options for entering data should be easily accessible on worksheets within the Tool. The tourism component also has a summary page with an option to export final results.

Navigating the Tool

The Tool may be navigated using the linked underlined cells available on many pages. In the upper left-hand corner of each page, short text containing information on the current location with a link back to the start of the section can be found. In the upper right-hand corner are links to the previous and next pages. The Help button, found in the upper-right of each page, also contains a navigation menu.

Both the Tourism and Fisheries Tools are designed so that one can start at the beginning of the Tool and work forward in a stepwise manner. Please work through the pages, entering data in the appropriate fields. On the valuation calculation pages, the Tool will use entered data to generate estimates of coral reef associated values. If at any time you want to see how the Tool calculates an estimate, see the *Calculations* Appendix at the end of this manual or click on the “Calculations” tab in the Tool.

Data may be entered in a number of different ways, to account for the different types of data that may be available for the selected study area. For instance, if you have detailed dive revenue data for your island, enter that type of information. If only aggregate numbers (or best guesses) are available, use that method for calculation.

Multiple Years

In the Fisheries Tool, data can be entered for one or more years. While data for all components ideally would be for the same period, availability may require different components to use data from different time periods. If data for only one year are entered, information for that year alone will be calculated. If data exist for multiple years, an average will be computed, generating a value for a “typical year.” The subcomponents of each of the Tools are calculated discretely and added together – even if data are for different years.

Fisheries Valuation Tool

The purpose of the Fisheries Valuation Tool is to estimate the economic value and economic impacts of coral reef goods and services coming from the Fisheries sector.

Components

The fisheries component of the Coral Reef Valuation Tool calculates four distinct subcomponents that are then added together to equal the total valuation for reef fisheries. The four subcomponents – commercial fisheries, fish processing and cleaning, local fishing, and multipliers – are calculated on separate worksheets within the Tool. The first three subcomponents calculate the direct economic value from the respective sectors of the fisheries industry, whereas the multipliers subcomponent calculates the indirect economic impacts arising from the fisheries industry as revenues filter through the region/economy of interest.

In each of the sections of the Fisheries Tool, there is a page (or section of a page) allowing the user to input data, and a page (or section) showing the valuation of the subcomponent. The “Total Fisheries Value” page lists each of the subcomponents and calculates the total value in both US Dollars and the specified local currency.

The following sections will guide you through the process of entering data and arriving at values using the Fisheries Tool. The Tool is designed to be a stepwise progression of the subcomponents – information should be entered in order, with the total valuation coming at the end. Appendix I provides guidance on the type of data required to complete the valuation.

Site Description Worksheet

On this worksheet, enter relevant background information about the study site. Some of the information is descriptive and useful for providing context when comparing the study site to other Caribbean countries or making a policy argument. Information entered on the starred lines (population of site, extent of coral reefs, local currency) will be used later in the Tool and must be provided to carry out the valuation.

Site Description -- Setting Local Currency

The Fisheries Tool allows for data to be entered in two different currencies (US\$ and a local currency). To set a local currency throughout the tool, select the currency from the drop-down list. Once a local currency is selected, click the “Set Currency” button. **Note: *Be sure to set the local currency before progressing to further sections. Since price data will often be available in a mix of US and local currency, the Tool allows for US dollars to be used at any point, even after a local currency has been set.***

Figure 1: Setting the Currency

Rate per US Dollar	Year

Fisheries Main Menu

From the Fisheries Main Menu, the user can select other pages in the Tool.

Fisheries Profile Worksheet

This worksheet contains background information about the fisheries sector in the study site. Fill out the fields for data that are available. Currently, only the data on the number of full-time or part-time fishermen is required for those choosing to value the coral reef fisheries using the method of the number of fishermen; however, the other data are important to provide context to the valuation estimates.

Commercial Fisheries Component

The value for Commercial Fisheries is calculated by tallying the revenue earned from reef-associated fish catch and subtracting the estimated operating costs. Commercial fisheries are treated separately from local fishing use, which corresponds to informal fishing for consumption, sale, or simple enjoyment. The revenue from commercial fisheries is based on fish catch and fish price (averaged over the year) for each reef-associated species. Fishing costs are based on estimates of the labor and operating costs to the fish boat owner.

Commercial Fisheries Default Values Worksheet

The information entered on this worksheet is used to estimate the costs in the commercial fishing and processing sectors. To complete this worksheet:

- Enter the percentage of labor and non-labor operating costs for commercial fish harvesting (Note: If fishermen simply divide the catch, labor should not be included as a cost)
- Enter the percentage of labor and non-labor operating costs for the fish processing sector

Non-labor operating costs include items such as fuel and fishing nets, whereas labor-operating costs include wages paid to employees engaged in the activity of harvesting or processing. Please enter all information to the best of your knowledge. While this information may vary by boat or by location, typical or average cases should be used. If you do not have any reliable estimates, please click “Use Default Values” and default values will be entered automatically for these cost measurements.

Commercial Fisheries Data Worksheet

On this worksheet, there are three options for entering data for commercial fisheries: (1) species catch data by landing site; (2) catch data by fishermen; or (3) fish abundance by reef extent. Users can choose the best option based on the available data for the study area (see Box 1). Depending on the amount and type of data available, users can also explore how choices of alternate calculation methods may yield different results to evaluate the sensitivity of the valuation estimates. Click on the three buttons at the top of the screen to switch between the commercial data options. Before entering data, please specify the currency (\$US or Local Currency) and the weight unit in the upper left-hand corner.

If you wish to use national-level catch data, select the “enter species data by landing site” option, and treat the country as a single landing site. Enter “national catch” as the landing site name. Please be sure to focus on reef-associated species (species will vary somewhat by country).

Box 1: Selecting an approach for Commercial Fisheries

The Fisheries Valuation Tool supports three methods for entering data on the commercial fisheries sector. Information can be entered:

- (1) by landing site;
- (2) by fisherman; or
- (3) by the extent and productivity of the reef.

Information based on landing site, if available, will likely be the most reliable for most sites. If detailed information exists for select fishermen, especially in a small study area, using the fishermen option may be a good approach. If there does not exist reliable data on catch either by landing site or by fisherman, users are encouraged to estimate the value of the catch based on reef extent and productivity. For all of the calculation methods, be sure to limit the data to reef-related species (see Appendix I for guidance).

- (1) **Species catch data by landing site.** If catch data are available by landing site, this is the recommended way to calculate the value of commercial fisheries. Catch data can either be entered in directly or imported from a file.

To Enter Data

To calculate the value of commercial fisheries by directly entering data using this approach:

- (1) Select whether you would like the data included in the valuation.
- (2) Enter the landing site names under “Landing Site 1,” “Landing Site 2,” etc.
- (3) Fill in all of the necessary columns (including species/species group, year data collected, average price, and weight of fish catch for each of the landing sites).

As market prices may vary over the course of the year, enter an average or weighted average price for the year. If you wish, you can also designate separate entry lines for local versus export sales, if the data are available. You may enter data in any order; however the Tool will only process rows where the species/species group name is entered. Additionally, if a name is not specified for a landing site, the Tool will not count the data entered for that site.

To Import Data

Cutting and pasting information in the tool is not recommended. Hence, if there is a large amount of data, it may be easier to create a separate file to organize the data, and then import it into the Tool. Data entered into this separate worksheet must match the formatting of the Tool – beginning in the first column, enter headings for Species, Year, and Price, followed by the Landing Site name(s) (see Figure 2).

Figure 2: Species Catch Data by Landing Site

	A	B	C	D	E	F
1	Species	Year	Price	CASTRIES	CHOISEUL	DENNERY
2	Squirrelfish	2002	10	519.37	684.24	75.2
3	Squirrelfish	2003	10	799.54	2262.04	195.81
4	Squirrelfish	2004	10	328.015	456.43	3.76
5	Snapper	2002	10	2061.76	150.79	41.36
6	Snapper	2003	10	26736.09	2233.72	7374.35
7	Snapper	2004	10	6829.74	0	381.64
8	Parrotfish	2002	10	61.69	253.36	814.35

Once the sheet is filled out, the information can be imported into the Tool by clicking on “Import Values” (in red). Be sure to enter the path containing the file (such as “c:\tool_data\”) and include the file name. *There is a template (commercial_fish_data_template.xls) provided along with the tool which can be used to assist with formatting data for import.*

- (2) **Catch Data by Fisherman.** If official statistics are not collected but data are available for a sample of fishermen, this sample can be used to estimate the total value of the commercial fisheries sector. Data needed for this approach are:
 - Employment status of each fisherman (full-time or part-time)
 - Year data collected
 - Species of Fish
 - Average annual catch (pounds or kilograms) per fisherman
 - Number of weeks of fishing per year for each fisherman
 - Average price per pound/kilogram catch

To calculate the value of commercial fisheries using this approach:

- (1) Enter the total number of part- and full-time fishermen
- (2) Enter catch and price data for each species. Each row contains data for an individual fisherman in a given year (see Figure 3). **Note: all data must be for the same year to estimate commercial fisheries value by fisherman.**

Figure 3: Calculating Fisheries Value Using Catch Data from Individual Fishermen

Number of Full-time Fisherman
 Number of Part-time Fisherman

				Species 1			
Include in valuation (yes or no)?	Fisher	Full- or Part-Time	Year Data Collected	Species	Average Amount Caught per Week (Pounds)	Number of Weeks fished	Price per Pound
Yes	Kevin Patterson	Full-time	2002	Grouper	20	20	\$12.00
Yes	Greg Rawls	Full-time	2002	Grouper	30	18	\$12.00
Yes	Dan Machs	Part-time	2002	Snapper	8	12	\$12.00

(3) **Fish Abundance by Reef Extent.** If catch data are not available from a sample of fishermen or according to landing site, the extent of the reef may be used to estimate the abundance of fish and, subsequently, the value of the commercial fisheries. To use the reef abundance approach, the following data are needed:

- Extent (area) of the reef
- Estimated productivity (or amount of fish caught per unit area)

Data on the extent of the reef can be entered manually or imported from the “Site Description” page. Average upper- and lower-bounds of reef productivity for the Caribbean region can be automatically entered by clicking on the “Guidance” button and selecting the appropriate unit of measurement (either metric tons per square kilometer, metric tons per square mile, or pounds per square mile).

Figure 4. Calculating Commercial Fisheries Value Through Reef Extent and Fish Abundance Estimation

Fish Abundance by Reef Extent Data

Reef Extent

	Area	Unit
Total Reef Extent	<input style="width: 100px;" type="text" value="2"/>	<input style="width: 100px;" type="text" value="sq. km"/>

Annual Reef Productivity

	Lower Bound	<input style="width: 100px;" type="text" value="2.6"/>	<input style="width: 100px;" type="text" value="metric tons"/>	<input style="width: 100px;" type="text" value="per sq. km"/>
	Upper Bound	<input style="width: 100px;" type="text" value="12.9"/>	<input style="width: 100px;" type="text" value="metric tons"/>	<input style="width: 100px;" type="text" value="per sq. km"/>

Price

Average Price of Fish Caught

Commercial Fisheries Valuation Worksheet

This sheet is where the actual calculation of the value of commercial fisheries occurs. First, select a method for calculating the results from the drop down menu. Be sure this selection matches the data you entered on the “Commercial Fish Data” page. To switch between methods of calculation, simply choose the desired method from the drop down menu and click “Restart Calculation.” Then select years if necessary and click “Calculate.” To restart the calculation at any time click “Clear” and the calculation will start over. *Note: If data in prior worksheets are revised or changed in any way, data needs to be recalculated by choosing clear and then clicking “Calculate” again. Data do not automatically refresh.*

Below is a brief description of how to use the tool to calculate the commercial value. For the specific equations used in the Tool for each calculation method, please refer to Appendix 1.

- (1) **Species catch by landing site.** To use this method:
 - Select “Calculate from Fish Landings” from the drop down menu
 - Select from the years that appear in the box below. You may select more than one year.
 - Click “Calculate”

For this method, information on the amount of fish caught for each species / type, and the year is compiled based on the landing site information entered in the data page. Current values are calculated for each species by using the most recent pricing. For instance, if data on grouper are entered for 2000, 2001, and 2002, prices for the most recent year (2002) are used in the calculation. Data are shown *as averaged annual values* for each species. For instance, if data exist for 1998, 1999, and 2000 for lobster, and each of these years are selected, the poundage used will be an average of those three years. Wage and operating cost information is calculated based on data entered in the “Commercial Fisheries Default Values” Worksheet.

- (2) **Catch Data by fisherman.** To use this method:
 - Select “Calculate from Fishermen” from the drop down menu
 - Select one year from the box which appears (the Tool currently allows for only one year to be selected)
 - Click “Calculate”

The Tool uses data entered on the data page and calculates the total value of the fisheries by using a weighted average of the fishermen entered for both part- and full-time fishermen, and then scaling this to the total number of fishermen. For instance, if data are entered for 5 part-time fishermen, of 50 total, the Tool will assume entered data constitute 10% of all catch by part-time fishermen. All price data must be entered on the data page.

- (3) **Fish Abundance by Reef Extent.** To use this method:
 - Select “Calculate from Reef Abundance” and then click “Calculate.”

The Tool will calculate upper- and lower-bound estimates of the value of reef fisheries using the upper- and lower-bound reef fish productivity estimates from the data sheet.

Fish Processing Worksheet

This worksheet calculates the economic contributions from the fish processing industries that add value to the fish catch in its movement from harvesting to the retail sector. Data required for this worksheet are:

- Year data collected
- Species or species group of fish processed
- Pounds of fish processed
- Cost of fish purchased for processing per weight unit
- Sale price of fish processed per weight unit

The Tool automatically sums the value of all purchased fish and sold fish, and expresses the value as the net revenue in the specified currency. For the specific formulas used in the Fish Processing calculations, please refer to Appendix 1.

Fish Processing Data

Data on fish processing can be either imported or entered directly. Fish processors typically purchase fish either from cooperatives or from fishermen and then resell at a higher value. This section of the Tool will capture this type of value added, whether for domestic consumption or for export.

To Enter Data

To enter data manually, fill in:

- Whether or not you want to include the data in the valuation
- Data year
- Purchaser
- Species/Species group
- Weight of fish processed
- Cost of fish purchased per unit weight
- Sale price of fish per unit weight

The Tool will automatically calculate the profit per pound and net revenue.

To Import Data

If there is a large amount of data, it may be easier to import it from a separate file. Enter data into a separate worksheet according to the figure below, or use the template, “fish_processing_data_template.xls.”

Once the sheet is filled out, the information can be imported into the Tool by clicking on “Import Values From File” (in red). Be sure to enter the path containing the file (such as “c:\tool_data”).

Figure 5: Fish Processing Data Entry

	A	B	C	D	E	F	G
1	Time Period	Purchaser	Species	Pounds	Purchase Price	Sale Price	
2	2005	Castries Depot	Potfish	21	\$8.00	\$10.00	
3	2005	Castries Depot	Potfish	333	\$8.00	\$10.00	
4	2005	Dennerly Depot	Grouper (Local)	855	\$6.00	\$10.00	
5	2005	Dennerly Depot	Snapper - Red (Local)	185	\$7.00	\$10.00	
6							

Cleaning Value Added Worksheet

Value added from cleaning refers to the economic value of processing fish at the landing site. Data on fish cleaning can be entered by (1) weight or (2) landing site. Select one the two buttons at the top of the sheet to choose the desired option. For the specific formulas used by each of these options, please refer to Appendix 1.

Option 1: Weight

If data is not available by landing site, select “Use Weight Calculations,” and enter:

- Percentage of fish catch cleaned
- Average value added per unit weight of fish

Option 2: Landing Site

If you decide to use ‘Cleaners by Landing Site’, enter:

- Landing site name
- Number of cleaners at landing site
- Average number of days per year that cleaners operate
- Average number of hours per day that cleaners operate
- Average earnings from fish cleaning per hour

The landing sites can be imported from the commercial fisheries screen by clicking on “Import Landings from Commercial Fisheries.”

After the data are entered for fish cleaning using one of these methods, move to the “Fish Processing Calculation Worksheet.”

Fish Processing Calculation Worksheet

The calculation page sums the net revenue from processing plants and informal (on-site) fish cleaning. For specific information on the calculations used for this segment, please refer to

Appendix 1. The Tool only includes costs from processing plants in the calculation; it assumes that most cleaners work for themselves, and that non-labor operating costs for landing-site cleaning are minimal. The currency used is the same as that in fish processing, however the weight unit may be specified.

Local Fishing Data Worksheet

The local fishing section is used to value any fishing conducted by locals on an informal basis that is not captured by official government statistics. In practice, the type and amount of local fishing will vary greatly by country. In countries where the commercial fisheries sector is primarily artisanal, this may not be a useful distinction – users will have to determine whether and how to apply the ‘local fishing’ designation within their area of focus. It is also worth noting that this section is the most likely to require survey-based data collection, since local fishing statistics are difficult to find.

The value of local fishing to the study area is divided into three parts: fishing for sale; for consumption; and for enjoyment. The Tool calculates each of these values separately, and adds them together to calculate the total local fishing value. Fishing for sale includes all artisanal fishing which is then sold to others, while fishing for consumption refers to fish caught for household consumption. Fishing for enjoyment (often referred to as “consumer surplus”) accounts for the additional pleasure derived from these activities.

To complete this worksheet:

- Select the weight and currency unit
- Enter the population of the site manually or click “Import” to automatically transfer this data from the “Site Description” worksheet
- Enter the estimates for the percentage of the population engaged in each of the local fishing activities
- Enter the average weight of catch per trip, average sale price per unit weight, and annual number of days people engage in local fishing for sale
- Enter the average weight of the catch per trip, the value of an average unit of catch and the annual number of days people at the site engage in local fishing for consumption
- Enter the average time spent fishing per day, the average annual days people at the site are engaged in local fishing for enjoyment, and the average hourly wage for the site

Please note that the time spent fishing can be *both* for sale and for enjoyment. While not all local fishermen may be fishing for dual purposes, these categories are not mutually exclusive.

Local Fishing Calculation Worksheet

On this page, the value of local fishing is calculated using the data entered on the “Local Fishing Data” worksheet. Click “Calculate” and the tool will automatically enter the results of the valuation of local fishing. For specific information on the formulas that form the basis for the

local fishing calculation in this tool for fish sale, fish consumption, and local fishing enjoyment, please see Appendix I.

Multipliers Worksheet

Multipliers can be useful as a means to estimate the indirect impacts arising from expenditures in one industry as the money filters through the backward-linked industries. For example, the expenditures of the commercial fishing/harvesting sector on boat maintenance and fuel generate additional economic activity as the boat maintenance and fuel industries use the additional revenue in the defined regional economy.

For the purposes of this worksheet it is possible to use either one multiplier for the overall fisheries industry or separate multipliers for the commercial fishing/harvesting and processing/cleaning sectors. The multiplier that you select is based on what is available for the economy or region being analyzed.

For example, if you have economic data indicating that each dollar of gross revenue generated in the fisheries industries generates an additional 40 cents throughout the regional economy, you should select the overall fisheries industry multiplier and enter 1.4. The multiplier of 1.4 will be multiplied by the sum of the gross revenue in the commercial fisheries (the harvesting sector) calculation plus the value added in the processing sector (value added in this case is the gross revenue in processing minus the cost of the fish: this avoids double counting the impact of the fish).

However, if you have economic data indicating that every dollar in commercial fisheries (the harvesting sector) generates an additional 40 cents throughout the regional economy AND data indicating that every dollar in fish processing generates an additional 50 cents throughout the regional economy, you would use separate harvesting and processing multipliers (1.4 and 1.5, respectively). In this case, 1.4 will be multiplied by the gross revenue from the commercial fisheries calculation and 1.5 will be multiplied by the value added in the fish processing sector (with value added as defined above).

For the specific calculations used by the multipliers, please refer to Appendix I.

To complete this worksheet:

- Select either “Overall Fisheries Industry Multiplier” or “Separate Harvesting and Processing/Cleaning Multipliers” in the upper right-hand corner
- Enter the value of the multiplier(s) in the cell(s); click on the “Guidance” button for further information
- If you choose to use no multiplier from the “Guidance” window, the default value of 1 will be entered; you may also manually enter “1” in the cell(s) if you do not wish to use multipliers. This will restrict your valuation to only direct economic impacts.

Please note that it is important to exercise caution when using multipliers for the value of fisheries. Multipliers are developed for a specific region and economy, and transfer of multipliers

between regions or economies may lead to inaccuracies in estimation of the indirect effects of the fisheries sector. It is important to be candid about these uncertainties when presenting the results. If there is a great deal of uncertainty about the accuracy of the multipliers, we recommend focusing on direct impacts as the value that can be presented with greater confidence.

Fisheries Value Worksheet

The fisheries value worksheet (shown in Figure 6 below) computes the total value of the fisheries section using the data has been entered into the various components of the tool (Commercial Fisheries, Fish Processing/Cleaning , Local Fishing, and Multipliers). For the Commercial Fisheries and Fish Processing/Cleaning sections, this summary page shows the gross and net revenues generated in these sectors (gross revenue only for fish cleaning) as well as the transfers to the economy from wages alone for these sectors. For specific information on the equations used for this page, please see Appendix I.

As these discrete components are calculated, component values are automatically filled into the “Fisheries Valuation” worksheet. This worksheet will compute the total value of fisheries using component data. By clicking “Calculate Total” at the bottom of the worksheet, all of the components will be summed together. The Tool will combine local and US currencies to compute total fisheries value. In this case, please be sure that the appropriate local currency has been specified on the Site Description worksheet.

If only certain components have been used – for instance, commercial fisheries and fish processing – but not others, the Tool will add in only those components. For components which have multiple methods of calculating value (namely Commercial Fisheries and Processing Value-Added), the Tool will also use whatever is the calculation method which has most recently been used. For instance, if data on commercial fisheries by landing and by fisherman exist, calculate this component using the appropriate method before calculating total fisheries value.

Figure 6. Fisheries Value Worksheet

Total Fisheries Value

This page shows the total value of the fisheries sector, as entered in previous sections. Values for individual sections are automatically entered below. To view total calculations, click the "Calculate Total" button below.

Calculate Total

Export to Spreadsheet

Study Area: Ambergris Cays, Belize, 2005

Scenario: best case estimates

1. Commercial Fisheries

	<i>In Selected Currency:</i>	<i>In US Dollars:</i>
Gross Revenue	17,788 \$TT	2,965 \$US
Net Revenue	11,562 \$TT	1,927 \$US
Transfers to the economy (Wages)	4,447 \$TT	741 \$US
Total Commercial Fishing Value	16,009 \$TT	2,668 \$US

2. Fish Processing and Cleaning

Gross Revenue from Processing	4,000 \$TT	667 \$US
Net Revenue from Processing Sale	-500 \$TT	-83 \$US
Transfers to the economy (Wages)	400 \$TT	67 \$US
Total Revenue from Cleaning Fish	12,000 \$TT	2,000 \$US
Total Fish Processing and Cleaning Value	11,900 \$TT	1,983 \$US

3. Local Fishing

Value of Local Fish Sale	5,000 \$TT	833 \$US
Value of Local Fish Consumption	12,000 \$TT	2,000 \$US
Value of Local Fish Enjoyment	900 \$TT	150 \$US
Total Local (non-commercial) Fishing Value	17,900 \$TT	2,983 \$US

Total Direct Economic Impacts (including local use)

	45,809 \$TT	7,635 \$US
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4. Indirect (Secondary) Economic Impacts

Indirect Effects Overall Fisheries Multiplier	10,136 \$TT	1,689 \$US
Total Indirect Economic Impacts	10,136 \$TT	1,689 \$US

Sensitivity Analysis

The sensitivity analysis included in the tool allows users to vary selected parameters used in the calculation of the commercial fisheries/fish harvesting revenues and costs. The parameters that may be varied on this sheet include:

1. Fish Catch
2. Fish Market Price
3. Commercial Fisheries Non-labor Operating Costs
4. Commercial Fisheries Labor Operating Costs

Since there are several different calculation methods provided in the tool, multiple simplifying assumptions have been implemented in the sensitivity analysis. These simplifying assumptions allow for easy manipulation of the parameters in the sensitivity analysis.

One of the simplifications is the use of an average price of fish in the sensitivity analysis, rather than the price by species group that is used in the commercial fisheries calculation methods (1) by landing site and (2) by fishermen. This simplification does not affect the estimation of the price of fish using the (3) reef productivity method for calculating the value of the commercial fish harvest since the average price of fish is already employed in that method. As a result the total revenue estimates in the sensitivity analysis do not precisely match the estimates obtained earlier in the tool for commercial fish value (1) by landing site and (2) by fishermen; however, as the species types entered are not known ahead of time, the use of an average value allows for a sensitivity analysis that determines how variation in the average price over all fish types may impact the gross revenues in the commercial fish harvesting.

The second simplification involves the estimate of fish catch if the (3) reef productivity method was initially used to calculate the value of commercial fisheries. The sensitivity analysis uses the midpoint between the lower and upper bound estimate of fish catch as the total fish catch. As such, the revenues, and consequently the costs, are estimated in the sensitivity analysis using this midpoint. Again, this simplification impacts the level of detail of the results compared with what was obtained earlier in the Tool, but easily allows for variation of parameters.

Total revenues are estimated by multiplying the average price of fish by the fish catch and then subtracting the total costs (the sum of labor and non-labor operating costs). The bar chart on the right of the spreadsheet provides a visual representation of the net revenues and total costs. Below the chart, you may also select different currency values for the chart (thousands, millions, and billions); depending on the magnitude of the commercial fisheries/harvesting sector in your location, it may be easier to view the chart in millions or billions of dollars.

APPENDICES

Appendix I – Calculations for Fisheries Valuation

A. Commercial Fisheries

The three approaches for calculating commercial fisheries revenues and costs are:

- (1) estimating values based on data from fisheries landings
- (2) estimating values based on data from individual fishermen
- (3) estimating values based on data from reef extent

(1) Calculations from fisheries landings

The tool will use the following equation to estimate revenues:

$$\text{Fishing Revenue} = \sum[(\text{fish price}_{s,y}) \times (\text{catch}_{s,y})]$$

Where

Fish price_{s,y} = Average market price of fish species *s* in year *y* (\$/kg)

Catch_{s,y} = Quantity of fish species *s* sold in year *y*

$$\text{Fishing Costs} = \sum \text{non-labor operating costs}_y + \text{labor costs}_y$$

Where

Non-labor operating costs = percent of total revenue that goes to non-labor costs

Labor costs = percent of total revenue that goes to wages

Note: the Tool assumes that the employees on the fishing boat are paid as a percent of revenues and that the operating costs are the same at all landing sites.

(2) Calculations from individual fishermen

Catch Data by Fisherman. If data is available for several fishermen, but official statistics are not collected, a sample of fishermen can be used to calculate total value of the commercial fisheries section. The Tool allows for two types of fishermen: part-time and full-time. Enter the total number of part- and full-time fishermen, and then begin entering data. In each row enter data for the species which are caught by each individual fisherman.

$$\text{Fishing Revenue} = \sum[(\text{fish price}_{s,y}) \times (\text{catch}_{s,y})]$$

Where

Fish price_{s,y} = Average market price of fish species *s* in year *y* (\$/kg)

Catch_{s,y} = Quantity of fish species *s* sold in year *y*

$$\text{Fishing Costs} = \sum \text{non-labor operating costs}_y + \text{labor costs}_y$$

Where

Non-labor operating costs = percent of total revenue that goes to non-labor costs

Labor costs = percent of total revenue that goes to wages

(3) Calculations from reef extent

If catch data are not available from fishermen or landing site, using the abundance of fish as determined by the extent of the reef is a third way to enter data. For reef abundance calculations, information on the extent (area) of the reef and the productivity (or amount of fish caught per unit area) is necessary. Data on the extent of the reef can be entered or imported from the site profile. Average upper- and lower-bounds of reef productivity for the Caribbean region can be automatically entered by clicking on the “Guidance” button. Select the desired units from the dialogue box.

$$\text{Fisheries revenues} = (\text{reef extent}) \times (\text{productivity}) \times (\text{fish price})$$

Where

Reef extent = area of reef in study area

Productivity = average amount of fish produced per unit area

Fish price = average sale price of fish sold

$$\text{Fishing Costs} = \sum \text{non-labor operating costs}_y + \text{labor costs}_y$$

Where

Non-labor operating costs = percent of total revenue that goes to non-labor costs

Labor costs = percent of total revenue that goes to wages

B. Fish Processing

$$\text{Processing Revenue}_y = \sum_{s,j} [(\text{processed fish price}_{s,j,y}) \times (\text{output}_{s,j,y})]$$

Where

Processed fish price_{s,j,y} = Average price received for processed fish for each species *s* for company *j* in year *y* (\$/kg)

Output_{s,j,y} = Quantity of processed fish for each species *s* sold by company *j* in year *y*

$$\text{Processing Costs} = \sum_{s,j} [(\text{fish price}_{s,j,y}) + \text{labor_costs}_y + \text{operating_costs}_y]$$

Where

fish price_{s,j,y} = price of reef fish purchased by processor for species *s* in year *y*

labor_costs_y = cost of labor for processing fish

operating_costs_y = other costs of processing fish

Note: The fisheries Tool does not currently estimate other fishing costs for processors

C. Cleaning Value Added

(1) Value added – weight calculation

Where

$$\text{Value added} = \sum [(\text{amount_fish}_y) \times (\text{p_fish_cleaned}) \times (\text{value})]$$

Amount_fish = amount of fish sold in year y

p_fish_cleaned = percent of fish cleaned

value = average value of fish cleaned (by weight)

(2) Value added – cleaners by landing site

$$\text{Cleaning Fish Revenue}_y = \sum_i [N_{i,y} \times D_{i,y} \times H_{i,y} \times \text{cleaning_earnings}_y]$$

Where

N = number of cleaners at each landing site *i* in year y

D_y = number of days cleaners work at each landing site *i* in year y

H_y = number of hours per day cleaners work at each landing site *i* in year y

cleaning_earnings_y = average hourly earnings from cleaning fish in year y

D. Local Fishing Calculation

(1) Local fishing for sale or consumption

$$\text{Subsistence Revenue}_y = \sum_s [(\text{fish price}_{s,y}) \times (\text{sub catch}_{s,y}) \times (\text{trips}_{s,y})] \times (\text{fishers}_y)$$

Where

Fish price_y = Average retail market price for fish in year y (\$/kg)

Sub catch_i = Average weight of fish caught on trip *i* per fisher (counting only fish caught for consumption)

N_y = Average number of trips or annual days in activity in year y per fisher

Fishers_y = Number of subsistence or local (own consumption) fishers in year y

(2) Local fishing for enjoyment

$$\text{Local Fishing Enjoyment}_y = \sum [\text{fishers}_y \times \text{days}_y \times \text{wage}_y]$$

Where

fishers_y = number of residents fishing for enjoyment in year y

days_y = average days spent fishing in year y

wage_y = average wage of selected population in year y

E. Multipliers

(1) Overall fisheries multiplier only

Indirect Economic Impacts = [(Gross Commercial Fisheries Value) + (Value Added Fish Processing) + (Gross Local Fishing Value)]*Overall Fisheries Multiplier

(2) Separate harvesting and processing/cleaning multipliers

Indirect Harvesting Economic Impacts = (Gross Commercial Fisheries Value) * Overall Fisheries Multiplier

Indirect Processing/Cleaning Economic Impacts = (Gross Commercial Fisheries Value + Value Added Fish Processing) * Processing/Cleaning Multiplier

The value added in fish processing in these equations excludes the cost of the purchased fish to avoid double counting the indirect impacts from the harvested fish.

F. Fisheries Value

Five key equations are used on the “Fisheries Value” worksheet.

(1) $Com_Fish = Net_Com_Fish + Com_Wages$

(2) $Fish_Processing_Cleaning = Net_Fish_Processing + Processing_Wages + Gross_Cleaning$

(3) $Local_Fishing = Local_Sale + Local_Consumption + Local_Enjoy$

(4) $Total_DI = Com_Fish + Fish_Processing_Cleaning + Local_Fishing$

(5) $Fisheries\ Value = Com_Fish + Fish_Processing + Local_Use + Multipliers$

Where:

Com_Fish =	Commercial Fisheries Value
Com_wages =	Wages paid in commercial fish harvesting sector
Fish_Processing_Cleaning =	Fish Processing and Cleaning Value
Local_Fishing =	Total value of local fish caught for sale, consumption, and enjoyment
Multipliers =	Indirect economic impacts of overall fisheries industry or of fish processing and harvesting sectors separately
Net_Com_Fish =	Net commercial fish harvesting revenue
Total_DI =	Total direct economic impacts of fisheries industry

Appendix II – Data Needs for Fisheries Valuation

This appendix lists the data needs to complete all sections of the fisheries valuation.

A. Commercial Fisheries Valuation

1. Fish landings approach
 - a. Year data collected
 - b. Species/species group
 - c. Sales price for each species/species group per unit weight at each landing site (kg/pound/metric ton)
 - d. Weight (kg/pound/metric ton) of each species of fish caught at each landing site
2. Individual fishermen
 - a. Year data collected
 - b. Number of full-time and part-time fishermen
 - c. Employment status of surveyed fishermen (full or part time)
 - d. Species caught
 - e. Average weight (kg/pound) catch/week by species
 - f. Number of weeks of year fishermen fish
 - g. Sales price of each species/species group per unit weight (kg/pound/metric ton)
3. Reef extent
 - a. Area of reef
 - b. Average annual reef productivity (fish catch per unit area of reef) – default values available in tool
 - c. Average price of fish caught on reef

For all of these approaches you will also need estimates of the labor and non-labor operating costs associated with the fisheries industry.

B. Fish Processing Valuation

- Year data collected
- Purchaser
- Species/species group processed
- Weight of purchased fish
- Purchase price for each species by unit weight
- Sale price for each species by unit weight

As with the Commercial Fisheries valuation, you will also need estimates of the labor and non-labor operating costs for the fish processing sector.

C. Fish Cleaning

1. Using Weight Calculations Approach

- a. Percent of fish catch (kg/pound/metric ton) cleaned
 - b. Average value added per weight unit (kg/pound/metric ton) of fish cleaned
2. Using Cleaners by Landing Site Approach
- a. Number of cleaners at each landing site selected
 - b. Average number of days worked by cleaners at each landing site per year
 - c. Average number of hours per day worked by cleaners at each landing site
 - d. Average revenue per hour received from fish cleaning at each landing site

D. Local Fishing

- Population of defined site
- Percent of population fishing for sale, for consumption, for enjoyment
- Average weight catch per trip for those engaging in local fishing for sale and consumption
- Sale price/value of average unit weight of catch for those engaging in local fishing for sale/consumption
- Average hourly wage for the population
- Average time spent fishing per day for those in the population engaging in local fishing for enjoyment
- Average annual days people at the site engage in local fishing for sale, consumption, or enjoyment

E. Multipliers

- Multiplier estimate for fish harvesting and processing industry OR multiplier estimate for overall fisheries sector

Appendix III. Glossary

Area of Coral Reefs: total area of coral reefs in the study site. For a comparison of three recent estimates of reef extent in Caribbean countries, see Appendix A, Table A1 in *Reefs at Risk in the Caribbean* (Burke et al. 2004): http://pdf.wri.org/reefs_caribbean_app1.pdf. Reef estimates are sensitive to the definition of coral reef, as well as the data sources and mapping techniques used.

Area of Mangroves: land area currently covered by mangroves in the study site. The user may decide to limit this to mangroves within 1 km (or another reasonable distance) from the coast.

Average unit price of Reef Fish / Shellfish: market price of reef-associated fish or shellfish, preferably by species, averaged over the course of 1 year. Market price tends to vary seasonally; average price can be weighted, if the user has the data and wishes to be more precise.

Coastal Shelf Area (to 30 meter depth): If detailed local data is not available, shelf area estimates for many Caribbean countries can be found in Appendix A, Table A2 in *Reefs at Risk in the Caribbean* (Burke et al. 2004): http://pdf.wri.org/reefs_caribbean_app1.pdf. Shelf areas in *Reefs at Risk* were defined based on a bathymetric data set developed at WRI from depth point data from the Danish Hydrologic Institute's (DHI) C-MAP data product, interpolated at 1-km resolution.

Coral Reef Valuation Tool: The Tool is made up of two separate components: the *Fisheries Valuation*, the *Tourism Valuation*.

Current Exchange Rate: So that the final values can be in a single currency, the Tool requires users to enter the current exchange rate between local currency and the US dollar. Both current and historic exchange rates are available online at sites such as oanda.com. If available data on fisheries, tourism, etc. are primarily a year or two old, the average exchange rate from that earlier year can be substituted for the current rate. Note: The Tourism Component is implemented in \$US only, while the Fisheries Component offers the option of enter data in the local currency.

Fish Cleaning: The Valuation Tool categorizes as fish cleaning any cleaning or processing of fish that occurs at landing sites (or on boats?), rather than in a formal fish processing facility.

Fish Processing: any cleaning, preparing, or packaging of fish that adds value to the sale price of the fish.

Full-time fishermen: fishermen who are employed for the majority of the year in the fish harvesting sector

Gross revenue: total revenues (income from sales) collected by a business or industry

Land Area: the total land area, including land under crops, urban land, forested land, etc. within the study site.

Land area under Permanent Crops: land cultivated with crops that occupy the land for long periods and need not be replanted after each harvest, such as cocoa, coffee and rubber; this category includes land under flowering shrubs, fruit trees, nut trees and vines, but excludes land under trees grown for wood or timber.

Landing site: the location where the fish are brought ashore by fishermen

Local Currency: the currency used in the site, if different from United States (US) dollars.

Local Fishing: Artisanal fishing that is not captured in national fisheries statistics. Catch is not brought in through official landing sites. Three components:

For Sale: local fishing with the intent of selling the catch – e.g. at local markets and restaurants. Component aims to capture some of the value not included in official figures. Calculated in the Tool as: (number of trips in a given year) x (amount of fish caught on each trip) x (average sale price of fish).

For Consumption: local fishing for household consumption. Calculated in the Tool as: (number of trips in a given year) x (amount of fish caught on each trip) x (average price of purchasing fish for consumption).

For Enjoyment: additional pleasure derived from local fishing for sale and consumption. Calculated in the Tool as: (number of trips in a given year) x (amount of time spent fishing in an average trip) x (average hourly wage in the study area).

Marine Protected Area: any area of the intertidal or subtidal terrain, together with its overlying water and associated flora, fauna, historical and cultural features, which has been reserved by law or other effective means to protect part or all of the enclosed environment (IUCN World Conservation Union).

Multipliers: the tools used to determine the indirect economic impacts for a region or economy arising from direct expenditures in a given industry; for example, a multiplier of 1.2 for the fisheries industry indicates that every dollar of revenue generated in the fisheries industry leads to another 20 cents in indirect impacts in the region/economy of interest.

Net Revenue: total revenue (income from sales) collected by a business minus the total costs of running that business.

Operating costs:

Labor costs: the amount a business spends on paying its employees. In the tool, this is sometimes calculated by multiplying average wage in the industry by number of employees and hours worked. For industries where this information is more difficult to collect, average labor costs for the industry can be estimated as a % of gross revenue.

Non-labor operating costs: all expenses incurred by a business except payment of wages, expressed as a % of gross revenue.

Part-time fishermen: fishermen who engage in commercial fish harvesting for less than the whole year

Population of site: total population living within the area being studied (if a national-level valuation - national population).

Population within 10km of the coast: total population living within 10km of the coast. (There may or may not be a reef present at the coast).

Reef Extent: See **Area of Coral Reefs**

Reef Productivity: Average weight of fish and shellfish caught per unit area of coral reef over a one-year time period. Similar to Maximum Sustainable Yield (MSY) per unit area.

Sensitivity analysis: investigation into how the output of the model—in this case, economic value—varies along with changes in the key assumptions on which the estimates are based.

Study Area: The geographic area included in the coral reef valuation. This may be a region, country, island, or sub-national site such as a Marine Protected Area.

Transfers: The movement of money within the region/economy of interest.

To the economy: Includes wages and service charges, for example, that are readily put back into the economy and available for further spending; in the fisheries Tool, wages are the transfers to the economy

To the government: Includes taxes as these involve the movement of money from expenditures in a given industry to the government.