Measuring the Blue Economy: The System of National Accounts and Use of Blue Economy Satellite Accounts

CDB Working Paper No. 2019/02

Justin Ram

Dindial Ramrattan

Raquel Frederick

CDB Working Paper No. 2019/02

Measuring the Blue Economy:
The System of National Accounts and
Use of Blue Economy Satellite Accounts

By Justin Ram, Dindial Ramrattan, Raquel Frederick

October 2019

JEL codes: C8, P44, Q01,

Keywords: Measuring the Blue Economy, Caribbean, Borrowing Member Countries, Caribbean Development Bank.

ISBN 978-976-96338-1-0

Corresponding author's email address: ramratd@caribank.org

Disclaimer

Acknowledgements

The authors would like to thank Carol Coy, Director-General of the Statistical Institute of Jamaica, and her team for the data and review provided in preparing this working paper. The valuable insight and methodological review of Zia Ahmad Abbasi, Real Sector Adviser at the Caribbean Regional Technical Assistance Centre, were vital in completing this project. Special thanks go to Sonia Hampden, Caribbean Development Bank, who provided executive support and review of the document.

Table of Contents

Abbreviations

BESA	-	Blue Economy satellite account
BMCs	-	Borrowing Member Countries
CARTAC	-	Caribbean Regional Technical Assistance Centre
CDB	-	Caribbean Development Bank
EUROSTAT	-	Statistical Office of the European Union
GDP	-	Gross domestic product
GVA	-	Gross value added
JMD	-	Jamaica dollars
mn	-	million
SNA	-	System of national accounts
STATIN	-	Statistical Institute of Jamaica
SUTs	-	Supply and use tables

Introduction

The objective of this study is to investigate the use of national accounts data in measuring the impact of increased investments in the Blue Economy, which is all economic activities originating from the ocean and its natural resources. The outputs from these activities may be demanded for final consumption, or as inputs into other productive processes (Caribbean Development Bank, United Nations Development Fund, 2018). The measurement of a country's national output is tied to its national accounting framework, which measures the contribution of individual industries to domestic economic activity. The researchers, therefore, propose to test the adaptability of the current national accounting systems to respond to changes in the outputs of Blue Economy industries.

As Small Island Developing States, countries of the Caribbean Region are pursuing a holistic approach to the resources of the ocean, focusing on the sustainable extraction of marine assets to improve their economic development and production possibilities. It is critical that these activities protect the long-term health of marine and coastal ecosystems for future generations. At the same time, the Region is directly dependent on Blue Economy activities as an important source of energy, food, recreation, and transportation. The Blue Economy is a significant driver of tourism activities in the Caribbean.

To fully understand the importance of the Blue Economy to the Region's growth, this paper uses available data from Jamaica's System of National Accounts (SNA) to estimate the direct and indirect growth impact of Blue Economy activities. To conduct the estimate through application of national accounting measurements, the researchers chose to apply a Leontief matrix to measure the intermediate and final demand of productive industries and the interlinkages between them. It is, therefore, possible to quantify the contribution of Blue Economy industries to total domestic output and the supply of Blue Economy products into the activities of other industries. The inter-industry analysis can inform policy-makers of potential demand increases in other industries arising out of a strategy to increase final demand within the Blue Economy.

The paper comprises four sections: (a) Blue Economy; (b) measuring the Blue Economy; (c) case study of Jamaica; and (d) way forward. The first section establishes key Blue Economy indicators and highlights the traditional Blue Economy industries in the Caribbean Region. The second section outlines the theory behind measuring Blue Economy activities and explains methodology used in the paper. The third section, case study of Jamaica, applies the measurement techniques from the second section, utilising data from Jamaica's SNA and estimates the potential intermediate and final demand from increased Blue Economy investments. The conclusion provides a synopsis of the activities required to provide for better measurement of Blue Economy and its contribution to national output.

The Blue Economy

In the Caribbean, the economic potential of the majority of the countries' maritime exclusive economic zone is significantly larger than that of their land area. In aggregate, the Caribbean's maritime area is almost 4.5 times the size of its land acreage (Saul, 2008), resulting in more than 70% of the Region's population settling along the coast and depending on the sea for subsistence and income (Royal Caribbean, 2017). Tourism also accounts for a large share of the total output of many economies and, apart from the dependence on seaports for trade, 64% of the Region's airports are located on, or near, coastlines (McFadden, 2013).

The ocean provides economic benefits to the Region and sustains the health of the land and populations. The Caribbean is highly vulnerable to climate change and rising sea levels. Defined as ecosystem services, the ocean plays a critical role in carbon dioxide absorption, nutrient cycling and coastal protection, all of which are important needs of Small Island Developing States. These activities ensure clean air, healthy and productive soil and, through reefs, protect the shoreline from rapid erosion. A salubrious ocean is, therefore, vital for the health of the environment and the population. For this reason, the extraction of the resources of the ocean and any land activity must be considerate of potential maritime impacts. The development of Blue Economy is concerned not only with the economic returns of the ocean, but also its care and longevity through sustainable practices.

Blue Economy Caribbean: Traditional Industries

This section of the paper identifies the traditional Blue Economy industries in the Region and looks at some of the key indicators supporting its importance. The three main industries of focus are: (a) fishing; (b) marine and coastal tourism; (c) marine transportation; and the role of the Blue Economy in trade systems.

The ocean is a source of income to households, companies, and governments. Households gain direct benefits from the ocean through economic and subsistence activities, such as fishing, marine and coastal tourism services, marine transportation and related services. Indirect benefits redound through the economic cycle as maritime activities facilitate much of the trade and tourism activities taking place. The traditional maritime industries provide an impulse to growth and development across the Caribbean.

Fishing

The fishing industry, while small in its economic contribution, remains a mainstay for many poor and vulnerable communities in the Region. Small-scale fisheries provide many coastal communities with income, employment and food security. Official labour market statistics exclude the informal labour in this industry, making it difficult to capture and analyse its full relevance. This is especially true when assessing the contribution of women in fisheries, who tend to participate in non-catch activities such as fish processing, packaging, and marketing (Lovell, 2018).

Regional economies often focus heavily on land-based agriculture, while minimising the fishing industry's capacity to spur economic growth and empower vulnerable populations. Similarly, development agencies and donor partners usually include fishing as a sub-set of agriculture investments or, often, leave the industry unstated in policy. However, analysis of the contribution of components of the agriculture sector demonstrates the outsized impact of fishing on the economy. Table 1 shows the respective value added contribution of fisheries expressed as a percent of agriculture. In five of 12 Borrowing Member Countries (BMCs) of the Caribbean Development Bank (CDB), that were surveyed, fishing, accounted for, on average, over a quarter of the total agriculture sector's value added between 2015 and 2019. In some regional economies, the fishing industry has significant potential to stimulate economic growth, if given the right investments and policy focus (P. McConney, 2009).

Table 1: Fishing industry as a percentage of the agriculture sector's value added, selected years, and BMCs with available data

Country	2010	2015	2019*	5-year average**
Anguilla	80	83	88	87
Antigua and Barbuda	48	51	52	51
Belize	20	18	10(2017)	17(2013-17)
Dominica	2	3	3	3
Grenada	28	16	18	18
Guyana	15	10	12(2016)	11(2012-16)
Montserrat	24	22	17	18
Saint Kitts and Nevis	30	33	37	35
Saint Lucia	23	22	22	22
Saint Vincent and the Grenadines	7	7	6	6
Suriname	26	46	n/a	35(2011-015)
Turks and Caicos Islands	77(2012)	86	87(2018)	86(2014-18)

Source: National statistical offices, central banks.
*Or latest available.
**2015-19

Marine and Coastal Tourism

The mass tourism model of the Region, which is based on coastal and ocean-related leisure and recreation activities, depends on the health of marine resources. On average, spending by visitors to Caribbean shores was 15% of the gross domestic product (GDP) of the Region from 2013 to 2018. This ratio varied significantly across countries, from as low as 1.5% in the commodity-exporters like Suriname to as high as 80.2% in service-based economies like the Turks and Caicos Islands (see Table 1).

The profile of the typical Caribbean tourist has evolved over the years. He or she is more likely to arrive by cruise ship, to stay for shorter visits, and to spend less in the local economy. Between 1989 and 2014, average daily expenditure declined from USD870 to USD608 per visitor (CDB, 2017). The decline was due to the increase of more budget-minded cruise passengers over long-stay visitors. During this period, cruise arrivals more than tripled while long-stay arrival numbers largely stagnated.

Table 2: Visitor expenditure as a percentage of gross domestic product by country (2014-18)

Country	2014	2015	2016	2017	2018	5-year average
Anguilla	47.0	45.5	46.3	50.2	37.9	45.4
Antigua and Barbuda	49.2	47.3	44.5	40.4	40.5	44.4
Bahamas, The	22.5	25.5	26.1	26.3	27.7	25.6
Barbados	19.6	21.0	22.5	23.4	25.6	22.4
Belize	24.8	24.1	25.8	25.3	30.6	26.1
Cayman Islands	13.8	15.2	17.9	18.6	20.0	17.1
Dominica	24.9	24.8	27.9	26.1	21.6	25.0
Grenada	16.1	16.4	16.0	15.7	20.1	16.9
Guyana	2.9	2.3	3.6	3.2	3.5	3.1
Jamaica	16.6	17.6	18.9	21.6	22.6	19.5
Montserrat	12.6	13.0	12.8	14.4	14.4	13.4
Saint Kitts and Nevis	15.5	15.9	16.2	18.4	20.7	17.3
Saint Lucia	60.2	60.8	59.0	64.9	70.1	63.0
Saint Vincent and Grenadines	13.1	13.3	13.7	12.9	13.9	13.4
Suriname	1.9	1.8	1.4	1.0	1.2	1.5
Trinidad and Tobago	1.9	2.3	2.1	2.0	2.1	2.1
Turks and Caicos Islands	72.4	76.8	84.0	78.8	88.8	80.2
Virgin Islands	51.8	54.5	58.3	48.0	26.6	47.8
Regional average	13.9	14.9	15.7	16.0	16.8	15.5

Source: Authors' calculations and Caribbean Tourism Organisation.

Despite the challenges, tourism still has a significant direct impact on Caribbean economies. Each USD100 increase in tourist spending is estimated to increase the local GDP by USD35-54 in that year, and by USD155-160 in the long term. Applying a Blue Economy approach to the development of the tourism industry may help to magnify this impact further, for example by increasing the economic linkages to the local economy and involve disadvantaged groups in the economic gains, while protecting the coastal and marine assets. The Region's tourism industry benefits from the range of coastal zone and offshore recreational activities that characterise its tourism product. Leisure and recreational activities around the coastline are significant attractions for international visitors and intra-regional tourists

Marine Transportation

Sixteen of 19 BMCs depend exclusively on the sea and air for transportation. While marine transportation tends to account for a smaller share of the sector, as demonstrated in Table 3:, this may be more likely due to challenges faced by the maritime transport sector rather than to higher demand for air transport. For example, financial constraints have curtailed efforts to maintain and modernise Caribbean ports, leading to inadequate infrastructure, inefficient operations, and unnecessarily high transport costs (CDB, 2016).

Table 3: Marine transport as a percentage of transport and storage sector's value added, selected years, and BMCs with available data

Country	2010	2015	2019*	5-year average**
Anguilla	24	27	26	27
Antigua and Barbuda	1	1	2	2
Dominica	12	8	7	7
Grenada	13	10	9	9
Montserrat	2	4	3	3
Saint Kitts and Nevis	1	1	1	1
Saint Lucia	12	11	10	10
Saint Vincent and the Grenadines	9	9	10	10
Turks and Caicos Islands	5(2012)	4	4(2018)	4(2014-18)

Source: National statistics offices, central banks.
*Or latest available.
**2015-19.

Trade

Maritime trade and shipping provide benefits through intra and extra-regional trade. The geographic make-up of the Caribbean economies necessitates either sea or air transportation for international trade, with the former accounting for almost 90% of all merchandise trade (Deambrosi, 2018), which is significantly high for many Caribbean countries (Table 4).

Table 4: Merchandise trade as a percentage of gross domestic product

Country	Average (1995-2006)	2007	Average (2008-2018)
Antigua and Barbuda	58.5	60.0	45.5
Bahamas, The	31.1	35.4	34.6
Barbados	46.3	48.6	46.8
Belize	77.9	85.2	86.1
Dominica	55.9	55.3	50.4
Grenada	48.5	52.5	43.0
Guyana	148.6	99.9	98.1
Jamaica	53.9	71.3	53.1
Haiti	36.8	37.4	52.2
Saint Kitts and Nevis	47.1	42.3	38.4
Saint Lucia	52.7	55.6	52.6
Saint Vincent and the Grenadines	55.0	54.8	54.1
Suriname	106.8	81.8	88.6
Trinidad and Tobago	88.8	97.3	86.5
Caribbean small states	61.8	72.7	66.5

Source: World Bank

Maritime transportation is important because of the Region's role in transshipment within the global shipping industry. The Caribbean is well poised to provide transshipment services for North American trade, given its position at the centre of the so-called shipping corridor between the Panama Canal and Freeport, The Bahamas. The available data suggests that the shipping industry continues to grow in many of the Caribbean countries and can provide a noticeable fillip to economic activity. Jamaica has been an early mover in this area with the recent upgrade of the Kingston Port, positioning the island as the leading trans-shipment hub in the Region. Such activities confirm the importance of this industry to Caribbean economies (see Table 5).

Table 5: Container throughput by country, selected years

	2010	2013	2017	Percent change (2017/ 2016)	Percent change (2017/ 2010)
Anguilla	2,853	2,465	7,512	7.0	163.3
Antigua and Barbuda	26,366	24,800	25,456	0.0	-3.5
Bahamas, The	1,125,000	1,379,300	1,200,000	-14.3	6.7
Barbados	80,430	74,900	105,321	21.8	30.9
Belize	31,900	41,000	44,000	-4.1	37.9
Cayman Islands	45,649	50,610	112,736	7.7	147.0
Dominica	14,000	7,469	7,553	0.0	-46.1
Grenada	15,000	16,100	17,250	7.5	15.0
Guyana	59,850	50,991	51,655	2.3	-13.7
Haiti	189,000	175,300	178,400	0.4	-5.6
Jamaica	1,891,770	1,703,900	1,689,000	2.2	-10.7
Montserrat	1,675	1,600	2,374	0.0	41.7
Saint Kitts and Nevis	7,100	7,000	10,326	8.7	45.4
Saint Lucia	52,456	64,400	38,383	-17.6	-26.8
Saint Vincent and the Grenadines	15,569	16,561	21,675	8.7	39.2
Suriname	59,583	108,020	113,800	6.0	91.0
Trinidad and Tobago	573,217	574,132	427,427	-17.9	-25.4
Caribbean	4,191,418	4,298,548	4,052,868	-5.3	-3.3
World	560,328,404	656,332,800	752,714,321	6.0	34.3
Caribbean as a % of world	1.0	1.0	1.0		
Annualised growth rate		1.2	-5.3		

Source: United Nations Conference for Trade and Development.

Measuring the Blue Economy

This section places attention on the current method of measuring national output throughout the Region and the methodology applied in estimating the intermediate and final demand from increased investments in the Blue Economy. The section is divided into two parts: (a) the system of national accounts (SNA); and (b) satellite accounts and the Leontief matrix.

System of National Accounts

The SNA measures economic activity in an economy through a series of macroeconomic accounts. These accounts are created with strict adherence to internationally agreed standards and principles. The SNA boasts four characteristics that led to its wide acceptance as the main source of national income statistics. The statistics produced from the SNA are: (a) universal[1]; (b) transparent[2]; (c) harmonised[3]; and (d) flexible[4]. The broad and comprehensive nature of the SNA and the use of the relevant international classifications are critical to ensure comparability between, and within, reporting systems (EUROSTAT, 2014). First established in 1953, the SNA underwent a series of revisions and improvements to reflect changing economic systems and arrangements at the regional and international levels. The most recent iteration, the 2008 SNA, is largely adopted in the developed world and is in use across the Region, although a fraction of the Caribbean economies are still transitioning from the 1993 SNA (see Appendix 1). The 2008 SNA maintained the same accounting rules as the 1993 SNA but made adjustments for closer alignment of industries to other statistical manuals and included more details on the informal sector.

The macroeconomic accounts that are captured within the SNA describes the domestic economy and the relationships between its main economic agents (or institutional units[5]) of activity. The main economic agents within an economic system are: (a) producers; (b) households and non-profit institutions; (c) government; and (d) financial institutions. The SNA provides the details of these four main economic agents by measuring the production of commodities and the provision of services within the economic system, and the tracking of their uses as inputs into other productive processes (see Figure 1).

---

1 The SNA accounts for the largest reach of data on total production within an economy. Over time, the data collection and report system evolved to capture significantly larger shares of service output and production flows in and out of a country.

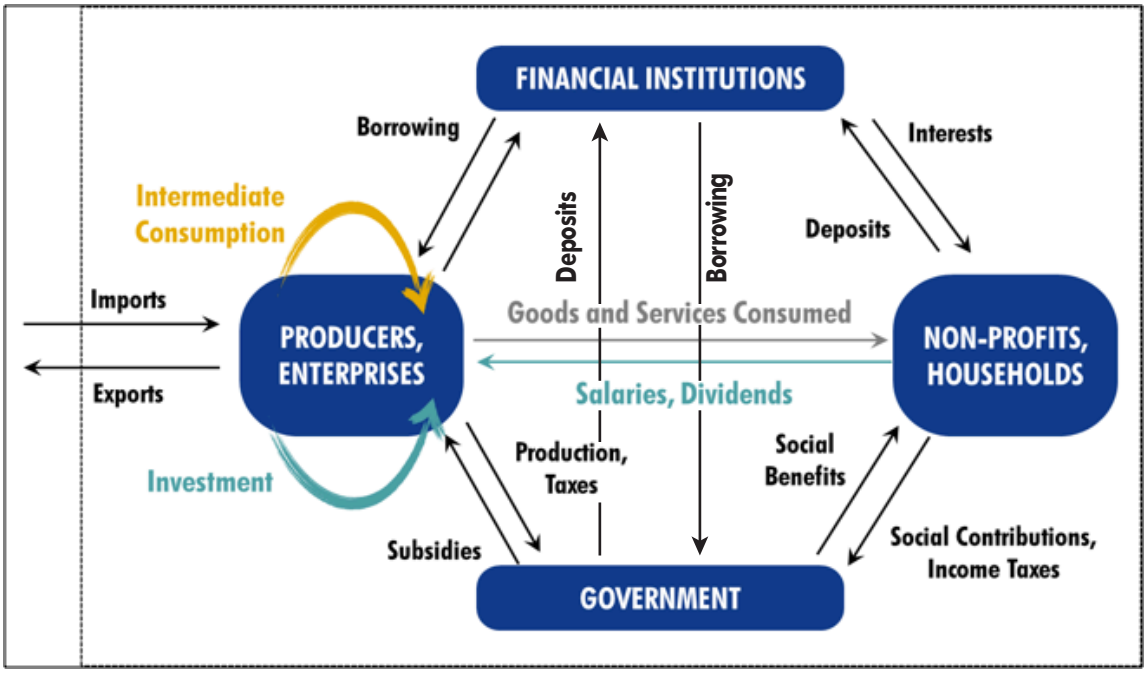
2 The accounting rules and guidelines are internationally developed and clear for public viewing. This has the added advantage of maintaining the interrogation of all data produced.

3 The SNA is harmonised with concepts and classifications that are present in other reporting systems, such as balance of payments, labour force survey methodology, and government finance statistics. This ensures increased complementarity with existing systems.

4 The use of satellite accounts allows a degree of national flexibility where countries can use specialised surveys to focus on areas of interest. Examples of such are tourism satellite accounts in Jamaica; and the use of an energy account in Trinidad and Tobago.

5 An institutional unit is an economic entity that is capable, in its own right, of owning assets, incurring liabilities and engaging in economics activities and transactions with other entities, e.g. CARTAC.

Figure 1: The national economy as captured in the system of national accounts



The compilation of all accounts within the SNA provides high-level indicators of GDP and identifies the main contributing industries and activities to economic output and growth. There are three main approaches to computing GDP using the SNA: (a) production; (b) expenditure; and (c) income. This paper focuses on the production approach because this method is the most used across the Region and can be easily discerned from the various publications of national statistics offices and central banks. Using either the expenditure or income method may exclude future work in countries that are not currently using those methods.

Equation 1 depicts the GDP calculation using the production approach, that is the net value added of the output of economic agents less the intermediate demands from other economic agents. Intermediate demand refers to the use of one economic agent's output as an input into the productive process of another. To calculate GDP, the SNA identifies the relationships between industries so that intermediate demand and final demand are clearly defined and recorded. Gross value added (GVA) measures the nominal value of goods and services produced in an economy less the cost of all intermediate inputs and raw materials. The addition of taxes and subtraction of subsidies calculates the cost of these goods and services to the consumer.

Equation 1: Total output of an open economy[6]

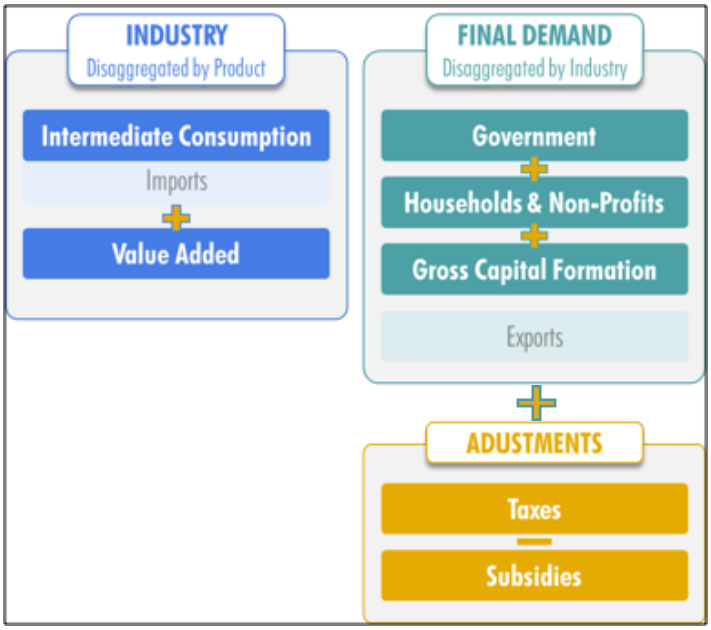
GDP at current market prices = GVA at basic prices + taxes on products – less subsidies on products

To compute the GDP, supply and use tables (SUTs) are produced,displaying the production

[6] An open economy is defined through the occurrence of international trade, thus exports and imports are part of the productive and consumptive processes.

and consumption of all economic agents at a sub-industry level. The SUTs include two tables in the calculation of value added: (a) a supply table capturing information on the output of all institutional units (domestic production and imports); and (b) a use table identifying intermediate and final consumption of goods and services, inclusive of exports. At the end of this process, the output of all institutional units within an industry is summed up, which provides the information on total activities within that specific industry (Figure 2). The sum of all industries activities produces the commonly referenced GDP statistic. This process requires the conduct of industry surveys and use of administrative and business establishment data. SUTs are the only method to generate an accurate and integrated visual of the domestic economy (Statistics Canada, 2019).

Figure 2: Supply-use framework



The accounting equation for the SUTs is built on a framework where the total supply must equal the total demand for the industry. To achieve this, the intermediate inputs into each commodity[7] must be separated from that industry's value added–the removal of any double counting of outputs. This step leads to the identification of each unit's GVA. The GVA for each product is then collated across all commodities within the respective industries to estimate the total output (Equation 2), accounting for adjustments of national taxes and subsidies. In some cases, the disaggregation may capture many units within one sub-industry and this leads to the same outcome, but with less ability to interrogate the data at a micro, i.e. firm, level.

Equation 2: Gross value added

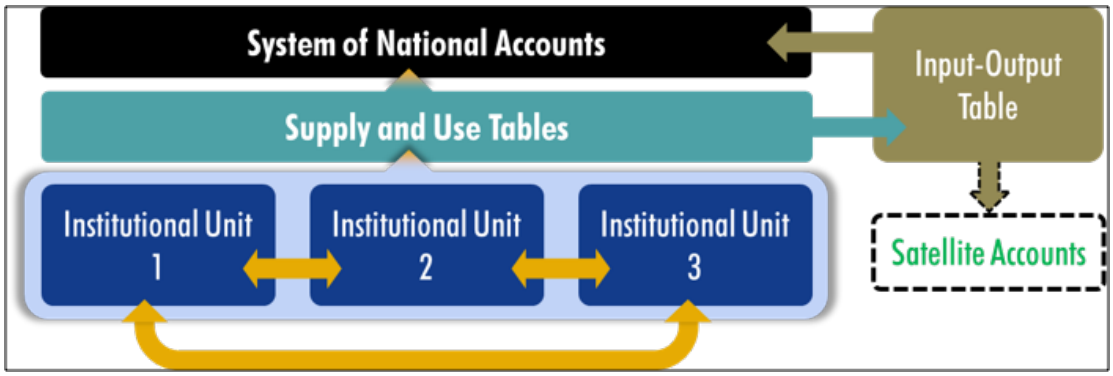
Where, for an economy with n industries,
(GVA)^n=∑_(i=1)^n1 productioni – intermediate consumptioni
Where:
n = number of economic agents

[7] Commodities refer to the actual items produced. A group of commodities forms an industry. For example, the production of different agricultural products (bananas, rice, sugar, etc.) aggregated to provide total agriculture output.

The SUTs feed into the computation of symmetric input-output tables that provide a representation of the producing sectors within an economy and the commodity flows between them (EUROSTAT, 2014). The input-output present the estimated contributions of all commodities into the economic process and depict the relationships in the form of a product-by-product matrix. Such a matrix provides disaggregated information on the relationships between industries and separates demand into domestic and foreign. By estimating the respective intermediate demand of industries, the input-output produce a quantification of the pass-through of resources from one industry to another and assists macroeconomists in estimating the relative indirect contributions of industries to economic growth, which cannot be gleaned from the high-level GDP by industry data.

Figure 3 represents the various linkages between the micro-level data (institutional unit) and the process by which it informs the wider SNA. The aggregation of micro data feeds into the SUTs where data is recognisable within the main activities taking place. The SUTs data then feeds into the input-output table. Some countries produce a basic SNA without the input-output table, but the more elaborate and accurate method uses the input-output table to inform the final SNA. It is useful to introduce the concept of satellite accounts here. Satellite accounts link the central accounts of the SNA and target the computation of industry level data for an area of interest. Examples of currently used satellite accounts are energy, environment, health, and tourism.

Figure 3: System of national accounts process



Satellite Accounts and the Leontief Matrix

The satellite accounts capture information on a specific area of activity without interfering with the wider process of the SNA. These accounts are interconnected, but more detailed accounts are calculated while computing GVA. The use of satellite accounts requires greater levels of data capture at the institutional level and hinders the use of such accounts in the regional space. In developing SAs, national accountants create a series of interlinked industry tables showing the demands and supplies of the relevant products and services.

It is not possible to create satellite accounts for all economic activities within a country because of the significant time and human resource demands required to capture data and prepare such accounts. Data capture for satellite accounts includes a series of industry surveys collecting information on the inputs and outputs of each process, a system to quantify the intermediate demands from other domestic productive sectors, and computation of each industry's value

added to national growth. Despite the significant resource demands, national statistics offices often prepare satellite accounts for important industries to their respective countries productive process.

The practice of using satellite accounts for ocean-related activities is recent, but increasingly common. In 2015, the Philippines agreed to assess ocean-based economic activities within its SNA using the latest version of the International Standard Industry Classification (Talento, 2016) and in 2016, Portugal launched the first SA for the Seas in Europe (Accounts, 2016). At a disaggregated level, these satellite accounts identify specific activities within maritime and maritime-related industries.

Once integrated within the wider SNA, satellite accounts will provide time series data on ocean-related activities and assist government and industry in identifying the direct and indirect benefits of activities within the Blue Economy. Satellite accounts enable reporting countries to measure and present data on specific areas of economic activity. Such identification is critical to determining the resource needs to develop Blue Economy industries. Essentially, the setting up of the Blue Economy satellite account (BESA) details the demand for merchandise trade and services associated with the Blue Economy. This demand interfaces with the total industry supply of identical products and services. To achieve the assessment of demand impacts from industry changes, the input-output is used to calculate a Leontief matrix. The Leontief matrix represents an economy where a number of industries are operational and measures the relationship of each industry's demand to the economy's total output.

The analysis in this paper utilises a Leontief inverse matrix to estimate the potential output impact resulting from an increase in final demand across the industries of the economic system. The steps in achieving this requires an input-output for the respective country and a series of calculations based on an amalgamation of economic agents into industries. The amalgamation produces an input-output matrix by broad industries (Z matrix) displaying the intermediate supply and use within the industries of the country's economic system. This amalgamation highlights the inter-industry flows and dependence between producing units. Following the amalgamation, the matrices were measured according to their respective contributions to total value added and their unit matrices were calculated resulting in the industries matrix (A matrix)[9].

At the A matrix stage the input-output coefficients are identified and will inform the computation of the total industry requirements. To calculate the industry requirements, a Leontief inverse matrix is necessary. The A matrix establishes the inter-industry relationships and adjustments to final and intermediate demand that result from changes in any of the input industries (the Z matrix, in this case). To do this, the inverse of the A matrix less the identity matrix[8] [(I-A)-1] must be calculated. The multiplication of this result by the final demand provides an estimate of total output and intermediate demand for each industry. For analytical purposes, the model allows the researchers to change the final demand of specific industries and measure the estimated changes to intermediate and final demand in the other producing industries of the economy. This assessment can inform policy by providing the necessary evidence to justify increasing

[8] The identity matrix is a square matrix with a diagonal of 1's, and all other elements are 0s. The purpose of the identity matrix is to replicate multiplying by 1 in matrix algebra.

[9] All equation are in Appendix 2.

investments in one area of production by measuring the potential changes across the wider economic system.

Currently, statistics offices in the Caribbean do not provide enough detail for the disaggregation of Blue Economy industry-specific indicators and the respective contributions to national output. Therefore, the disaggregation of GDP into specific accounts, such as the Blue Economy, requires targeted data capture and analysis on the respective industries. The following case study provides an illustration of the satellite accounts analysis for the major Blue Economy industries in Jamaica. The Statistical Institute of Jamaica provided the SNA and detailed input-output data.

Case Study: Jamaica

This section provides an application of the aforementioned methodology to Jamaica. The case study will highlight the potential gains of using such an interventions.

The Government of Jamaica identifies the fisheries and tourism industries as the main focal areas for developing Blue Economy. The two industries account for approximately 10% of GDP and total formal employment, and probably even more numbers within the informal sector (Hunter, 2018). More than 95% of Jamaica's tourism is inbound (from outside of Jamaica) and the country benefits from its attractiveness to tourists from Europe and the United States of America. Comparatively, Blue Economy indicators suggest that almost 3.5% of the country's GDP comes directly from marine sources. However, to quantify Blue Economy contribution to GDP, analysis using satellite accounts is required—much like the tourism SA that is operational in Jamaica. The BESA will provide a more detailed and tested approach to estimate the contribution of the ocean's resources to national growth and development (both directly and indirectly).

The first requirement in producing the BESA is to identify the industries that form the Blue Economy. This is important to ensure that their respective activities are assigned and accounted as part of the BESA. Theoretically, one can account for current and emerging activities to be included in the BESA, but for the purposes of this paper, and given the data limitations, the focus is on activities that are current and captured within the SNA. In the research, the main Blue Economy activities and related industries reported are listed in Table 6.

Table 6: Proposed activities for Jamaica's Blue Economy Satellite Account

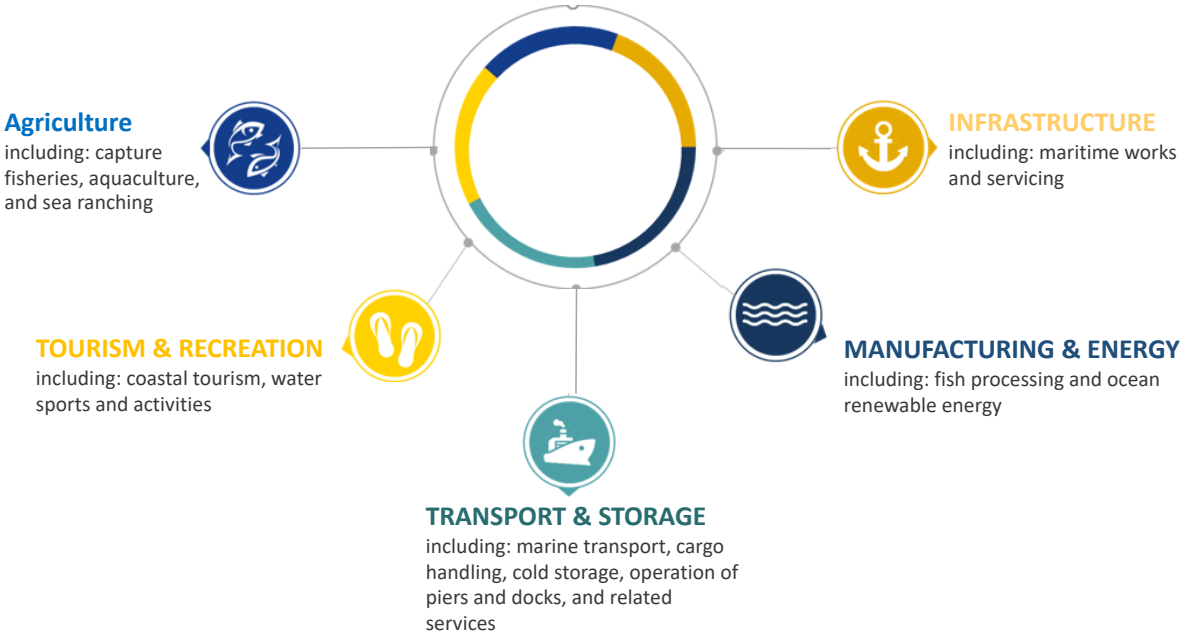
Industry	Activity
Fishing	Capture fisheries
	Aquaculture, including sea ranching
Transport, storage and communication	Sea and coastal water transport
	Cargo handling for water transport, including stevedoring
	Warehousing, including bonded warehousing
	Cold storage
	Operation of piers, docks, lighthouses, and navigational facilities
	Shipping agencies and brokerage
Arts, entertainment, and recreation	Custom brokers, forwarding, packing and crating agents
	Safaris and plantation tours, including rafting
	Snorkelling, underwater viewing, and related activities
	Operations of beaches and recreation parks
Manufacturing	Fish and seafood processing
	Energy

Source: Statistical Institute of Jamaica (STATIN).

Upon investigation of Jamaica's SNA, there are four main industries where blue activities are taking place and measured in the reporting of GDP: (a) manufacturing[9]; (b) transport and storage; (c) agriculture, forestry and fishing; and (d) arts, entertainment, and recreation (see Figure 4). While these accounts provide a listing of direct impacts, it is critical to understand that large indirect impacts are often excluded. To overcome the exclusion, a country needs to conduct a national survey to supplement SUTs and build the framework to measure other direct and indirect impacts of the Blue Economy. For example, Blue Economy is a significant driver of the tourism industry and can be attributed to a share of the gains in the hotels and restaurants, and passenger transport industries.

An assessment of the relevant activities and industries within Jamaica's SNA estimates a BESA with a measureable and direct impact of 6.9% of GDP in 2017 and an average contribution of 6.7% for the period 2012 to 2017. This value is based on the computation of GVA of the activities that are directly related to the country's marine resources. The single largest activity is visitor accommodation[10] (just under 3.5% of GDP in 2017) and also notable is the contribution of maritime transport to GVA, a little more than 2% in 2017.

Figure 4: An integrated Blue Economy satellite account for Jamaica



[9] Blue Economy activities will be an input into the process, such as fish and seafood as inputs into food processing.

[10] Visitor accommodation under tourism is included as an indirect benefit of the Blue Economy, with a large number of hotels located on the beach and making use of the country's ocean resource as a source of recreation. Further studies on tourism and the Blue Economy can assist in quantifying the exact contribution of the Blue Economy to tourism, mainly the accommodation services.

Table 7: Blue industry indicators, percentage of gross value added (direct and indirect)

Indicator	*2012*	*2013*	*2014*	*2015*	*2016*	*2017*
Visitor accommodation	3.1	3.2	3.4	3.4	3.4	3.4
Maritime transport	2.1	2.1	2.1	2.0	2.0	2.1
Fishing	0.4	0.4	0.5	0.5	0.5	0.5
Tourism and recreation services	0.8	0.8	0.8	0.8	0.8	0.9
Blue Economy activities	6.4	6.5	6.8	6.7	6.7	6.9

Source: STATIN.

Taking this assessment further, the authors derived an input-output table by industry to estimate the linkages between the two identified industries for Blue Economy growth (fishing and tourism) and their potential impact on overall GDP. For the purposes of this analysis, and based on the available data, the products and institutional units were amalgamated into six main industries: (a) agriculture; (b) fishing; (c) manufacturing; (d) services; (e) transport; and (f) hotels and restaurants.

Based on the assessment, the output of each industry was separated into final and intermediate demand. The findings showed that investments in hotel and restaurants passed through immediately, with its output being almost entirely demand for final use (94%). As a result, any investment in this industry will create a significant uptick in GVA of the tourism industry. This is one of the key pillars identified by the Government of Jamaica for a national Blue Economy strategy. Interestingly, the other Blue Economy industry earmarked for development exhibits a similar pattern, albeit at a lower magnitude. Fishing is largely demanded for final consumption (76%), with the majority of its intermediate demand connected to the manufacturing, and hotels and restaurants industries. The finding clearly identifies a seamless pass-through of Blue Economy industries to the total value added of the economy and significant potential the domestic labour force.

Table 8: Industry output by percentage demand

Industry	*Demand for final use*	*Intermediate demand*
Agriculture	57	43
Fishing	76	24
Manufacturing	69	31
Services	67	33
Transport	50	50
Hotels and restaurants	94	6

The next stage of the analysis focused on the application of the Leontief matrix to ascertain demand changes from increased activities in any of the Blue Economy industries. In this example, the authors evaluated the result of a 10% increase in final demand by the hotels and restaurants industry. Appendix 2 shows the steps in this calculation starting from the amalgamation of the industries in the input-output tables to the Leontief matrix. Following the assessment, any investments leading to a 10%-increase in final demand of the hotels and restaurants industry generate growth of 1.1% in total domestic output (GDP). This increased final demand also has a spillover effect on the other producing industries, with fishing and agriculture growing by 1.6% and 1%, respectively.

Table 9: Impact of 10%-increase in final demand of the hotels and restaurants industry (Jamaica dollars billion)

	J$ Billion		
	Total output (fi-n)	**Total output (f6+0.1x6)**	**GDP %Change**
Agriculture	71.3	72.0	1.0%
Fishing	5.6	5.7	1.6%
Manufacturing	340.5	342.6	0.6%
Services	947.0	951.1	0.4%
Transport	123.4	123.7	0.3%
Hotels and Restaurants	108.1	118.3	9.5%
Total GDP impact	**1,596**	**1,613**	**1.1%**

The application of this model highlights the important role that such analysis has in estimating the potential gains from investing in Blue Economy strategies to drive tourism and measuring the resulting impact on the wider economic system. Additionally, by estimating the potential demands on other industries, policy-makers can take the necessary steps to ensure that other producers are prepared for any oncoming increased demand. Such actions will enable the economy to be sufficiently resourced to increase output as needed, and reduce the need for any imports as a buffer to the productive process. The ability to measure intermediate demand is also important as it highlights the full returns on investments within the Blue Economy by ensuring all uses of Blue Economy products are measured and accounted. Being able to monitor the inter-industry linkages and returns are critical to understanding the true benefits of such a strategy and identifying areas where improvements can be made.

Way Forward

In the Caribbean, home to a thriving ocean-based economic system, there is an urgent need to properly assess and monitor the exploitation and consumption of the existing marine resources. Investments in this area must be cognisant of the need for sustainable practices and the true returns on investments. This process requires strong data collection and a concerted effort by policy-makers to use this data to drive the decision-making process. It is essential that the Region begins to measure the critical role the ocean plays in its development and take the necessary steps to continuously monitor the impacts of this resource on the respective domestic economies.

National accounts data used by governments, industry and academia to inform the process of evidenced-based decision-making, and provide valuable research support in the economic cycle. The use of satellite accounts and input-output tables highlights the international and inter-industry flows of economies. Such analysis provides inputs into the development process and ensures that policy-makers have the full breadth of evidence to make investment decisions for industrial growth within an economy. The analysis proves critical in assessing the roles of different economic agents within the targeted sectors and assists in monitoring the returns on investments with the use of satellite accounts and the associated analytical models available. This practice requires further investments to be mainstreamed in its supply to all stakeholders and used within the national development process.

The case study of Jamaica shows the valuable insights that the use of SUTs and input-output data can provide in assessing the value of investing in particular productive activities. However, the Region is stymied in its ability to conduct such assessments because of a lack of funding for the necessary data capture. For example, the ideal breakdown of SUTs should be able to identify the majority of products supplied and used within the Blue Economy to evaluate the levels of inter-industry linkages and contributions to national output. To achieve this breakdown, a country needs to conduct a national survey to supplement SUTs and build the framework to measure other direct and indirect impacts of the Blue Economy. Such an effort requires funding and a focused effort by data producers and suppliers to provide the inputs to national statistics offices.

It is strongly recommended that efforts to increase the capture and use of the ocean's resources for economic gains are accompanied by improvements in the statistical system to monitor and evaluate the resulting impacts on national output and supply of other productive sectors. Such evidenced-based analysis can help economies to prepare and provide for any increased activity due to investments in the Blue Economy. For the Region, the Blue Economy does not only mean pursuing new activities or establishing new industries; in fact, a Blue Economy strategy for the Caribbean means doing what has always been done more efficiently, sustainably, and inclusively, along with some other specific new industries like marine renewable energy, such as offshore wind energy and marine aquaculture. The Region depends on its marine resources as a source of income, food, and security. While the Caribbean largely depends on its ocean resources as intermediate inputs into its tourism and trade activities, there are new and expanding opportunities available through the sustainable use of the ocean's resources. To fully maximise the potential gains from the Blue Economy, there is need for a well-articulated

strategy and policy directive towards maximising returns from the ocean, while protecting it for future generations. Having BESAs for every territory will allow for the economic measurement of the potential and real impact of Blue Economy activities and thereby assist with implementing sustainable Blue Economy strategies.

Bibliography

Accounts, D. o. (2016). Satellite Account for the Sea 2010-2013. Portugal: Directorate General for Maritime Policy, Statistics Portugal.

CDB. (2016). Transforming the Caribbean Port Services Industry: Towards the Efficiency Frontier. Caribbean Development Bank.

CDB. (2017). Tourism Industry Reform: Strategies for Enhanced Economic Impact. Caribbean Development Bank.

Deambrosi, S. (2018, September 11). IDB Blog. Retrieved on September 24, 2019 from moviliblog: transport and mobility ideas for Latin America and the Caribbean: https://blogs.iadb.org/transporte/en/short-sea-shipping-a-solution-to-caribbean-logistics-challenges/

EUROSTAT. (2014). Essential SNA: Building the Basics. Luxembourg: European Union.

Lovell, T. (2018). Understanding and Addressing Gender Inequality in Small Scale Fisheries: A Caribbean Perspective. Anitgua and Barbuda: United Nations Nippon Foundation.

McFadden, D. (2013, May 7). Phys Org. Retrieved on September 8, 2019 from phys.org: https://phys.org/news/2013-05-encroaching-sea-threat-caribbean.html

P. McConney, L. N. (2009). Impacts of climate change on small-scale fisheries in the eastern Caribbean: a final report to IUCN. Centre for Resource Management and Environmental Studies (CERMES).

Royal Caribbean. (2017, January 26). HuffPost. Retrieved on July 14, 2019 from https://www.huffpost.com/entry/save-the-reefs-how-to-preserve-the-caribbeans-epic-underwater-landscape_n_583daf54e4b0860d6116817c

Saul, H. A. (2008, March 25-27). Perspectives for the Development of the United Nations University (UNU) Fisheries Training Programme for the Caribbean. High-Level Roundtable on International Cooperation for Sustainable Development in Caribbean Small Island Developing States. Barbados: United Nations.

Statistics Canada. (2019, September 24). Supply and Use and Input-Output Tables. Retrieved on September 29, 2019 from Statistics Canada: https://www150.statcan.gc.ca/n1/pub/13-607-x/2016001/1050-eng.htm

Talento, R. J. (2016). Accounting for the Ocean Economy Using the System of National Accounts. Journal of Ocean and Coastal Economics, Article 5.

APPENDIX 1

BMCs and the system of national accounts in use

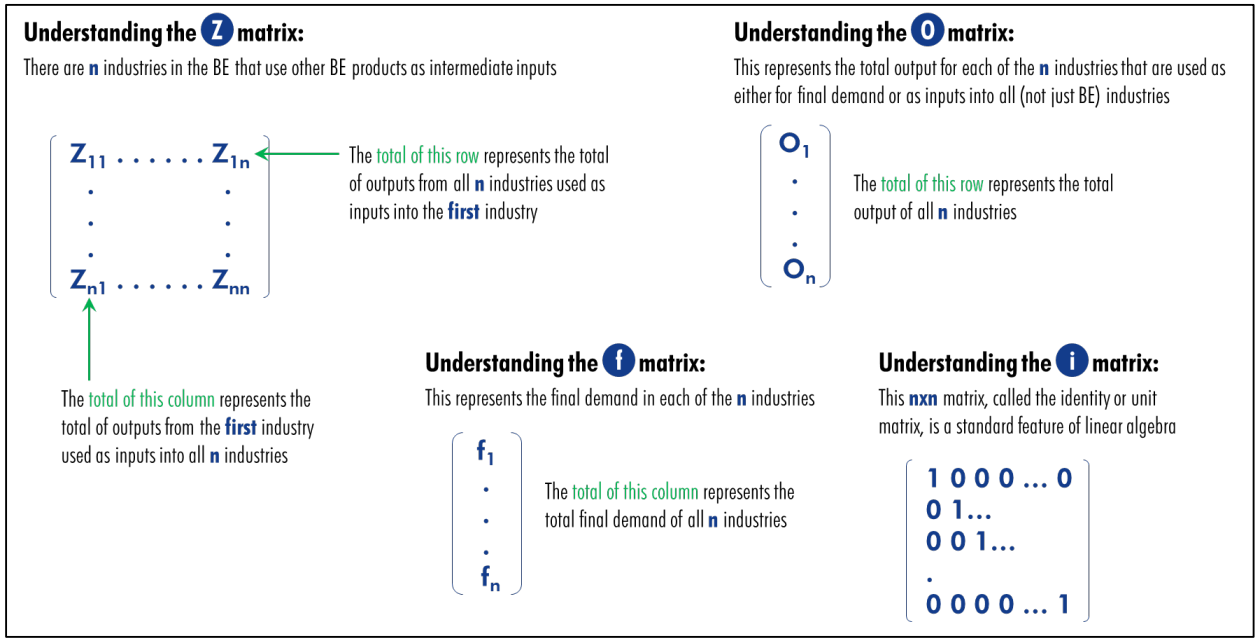
Country	Current SNA vintage
Antigua and Barbuda	1993
Anguilla	1993
Bahamas, The	2008
Barbados	1993
Belize	1993
Cayman Islands	2008
Dominica	1993
Grenada	1993
Guyana	1993
Jamaica	1993
Haiti	1968
Montserrat	1993
Saint Kitts and Nevis	1993
Saint Lucia	1993
Saint Vincent and Grenadines	1993
Suriname	1993
Trinidad and Tobago	2008
Turks and Caicos Islands	1993
Virgin Islands	1993

Source: CARTAC

APPENDIX 2

Matrices for input-output tables analysis

Methodology - Map of the analysis



STEP 1 Calculate A = Z ÷ O

A is the share of industry output used as inputs in each of the n industries

STEP 2 Calculate the (i-A) matrix = i − A

STEP 3 Calculate the inverse of the (i-A) matrix = $(i\text{-}A)^{-1}$

STEP 4 Calculate x = (i-A)-1 + f

APPENDIX 2

Methodology – Calculations

Matrix Z: Input-output by broad industry (JMD mn)

Industry	Agriculture	Fishing	Manufacturing	Services	Transport	Hotels and restaurants
Agriculture	5,022	-	19,080	602	1	5,904
Fishing	-	166	127	156	-	887
Manufacturing	11,921	511	29,778	45,745	2,960	16,587
Services	8,422	520	43,333	183,006	24,643	30,310
Transport	2,534	9	11,010	35,548	12,553	911
Hotels and restaurants	6	-	333	4,835	683	336

Matrix O: Industry and final demand consumption

Industry	Final demand
Agriculture	40,852
Fishing	4,267
Manufacturing	235,439
Services	665,843
Transport	62,684
Hotels and restaurants	102,117

Matrix A: Industries

Industry	Agriculture	Fishing	Manufacturing	Services	Transport	Hotels and restaurants
Agriculture	0.0703	-	0.0556	0.0006	-	0.0545
Fishing	-	0.0296	0.0004	0.0002	-	0.0082
Manufacturing	0.1668	0.0912	0.0868	0.0461	0.0236	0.1531
Services	0.1179	0.0928	0.1264	0.1845	0.1968	0.2798
Transport	0.0355	0.0017	0.0321	0.0358	0.1002	0.0084
Hotels and restaurants	0.0001	0.0000	0.0010	0.0049	0.0055	0.0031

Matrix I: Unit

Industry	Agriculture	Fishing	Manufacturing	Services	Transport	Hotels and restaurants
Agriculture	0.9297	-	(0.0556)	(0.0006)	(0.0000)	(0.0545)
Fishing	-	0.9704	(0.0004)	(0.0002)	-	(0.0082)
Manufacturing	(0.1668)	(0.0912)	0.9132	(0.0461)	(0.0236)	(0.1531)
Services	(0.1179)	(0.0928)	(0.1264)	0.8155	(0.1968)	(0.2798)
Transport	(0.0355)	(0.0017)	(0.0321)	(0.0358)	0.8998	(0.0084)
Hotels and restaurants	(0.0001)	-	(0.0010)	(0.0049)	(0.0055)	0.9969

[Matrix (i-A)-1]

Matrix I-1: Inverse matrix

Industry	Agriculture	Fishing	Manufacturing	Services	Transport	Hotels and restaurants
Agriculture	1.0884	0.0068	0.0672	0.0052	0.0033	0.0714
Fishing	0.0001	1.0305	0.0005	0.0003	0.0001	0.0086
Manufacturing	0.2110	0.1116	1.1190	0.0667	0.0452	0.2034
Services	0.2047	0.1386	0.1961	1.2522	0.2814	0.3964
Transport	0.0586	0.0117	0.0504	0.0525	1.1244	0.0353
Hotels and restaurants	0.0016	0.0009	0.0023	0.0065	0.0076	1.0054

Matrix X: Relationship of intermediate and final demand

Industry	Final demand (fi)	Total output (xi)	Demand for final use (%)	Intermediate demand (%)	Industry total
Agriculture	40,852	71,274	57	43	30,608
Fishing	4,267	5,593	76	24	1,336
Manufacturing	235,439	340,549	69	31	107,502
Services	665,843	947,029	67	33	326,107
Transport	62,684	123,365	50	50	62,565
Hotels and restaurants	102,117	108,078	94	6	6,193

What-if Analysis

Matrix: Response to 10% increase in final demand of hotels and restaurants

Industry	Final demand (fi+0.1)	Total output (xi+0.1)	% change
Agriculture	40,852	72,003	1.0
Fishing	4,267	5,681	1.6
Manufacturing	235,439	342,627	0.6
Services	665,843	951,077	0.4
Transport	62,684	123,725	0.3
Hotels and restaurants	112,329	118,345	8.7