An economic valuation and qualitative analysis of the commercial fishing sector in Montserrat

Abstract

The role of artisanal fisheries in the nutrition, food security and poverty alleviation for households all over the world cannot be underestimated. However, their socioeconomic relevance, especially in coastal tropical areas such as the Wider Caribbean Region (WCR), remains poorly understood. The Caribbean island of Montserrat is no exception to this, and almost no information about the economic value of its commercial fisheries is currently available. This study constitutes an attempt to fill in that void. Using both primary and secondary data, and by means of the net factor income approach, I estimated the gross and net value added of the commercial harvesting activities during 2016 at XCD 229,476 (USD 84,991) and XCD 174,906 (USD 64,780), respectively. The analysis by type of fishery suggests that, from a purely economic perspective, the overall value of the harvesting activities could be enhanced if at least part of the fishing efforts devoted to reef species were transferred to coastal and/or ocean pelagic species. To understand further the indirect contribution of the commercial fisheries to Montserrat´s economy, the amount of additional value that is created with downstream transactions was also estimated. When fish follows a pathway that includes cleaners and restaurants as intermediate actors before reaching the final consumer, an additional gross value of XCD 37.5 (USD 13.9) per kilogram of fish is created, multiplying the GVA of the harvesting stage by almost 4.5 times.

Key words: Commercial fishing, gross value added, net value added, net factor income approach, downstream effects, Montserrat.

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Contents

Acronyms and abbreviations

BOT - British Overseas Territory

CEM – Choice Experiment Method

CVM – Contingent Valuation Method

EC – European Commission

ECCB – Eastern Caribbean Central Bank

FAO – Food and Agriculture Organization

GDP – Gross Domestic Product

GOM – Government of Montserrat

GVA – Gross Value Added

JNCC - Joint Nature Conservation Committee

Kg - Kilogram

Lb. - Pound

MEA – Millennium Ecosystem Assessment

MP – Market Price

NAS – National Academy of Sciences

NOAA – National Oceanic and Atmospheric Administration, United States

NPV – Net Present Value

NVA – Net Value Added

TEV – Total Economic Value

UCSB – University of California, Santa Barbara

USD – United States Dollars

USVI – United States Virgin Islands

WCR – Wider Caribbean Region

WTA – Willingness to Accept

WTP – Willingness to Pay

XCD – East Caribbean Dollar

1. Introduction

The contribution of artisanal fisheries to the nutrition, food security and poverty alleviation for households all over the globe is far from negligible (FAO, 2004). Considering that these are responsible for around 50% of global fish landings and 90% of the world´s capture fishers, and that 90% to 95% of their catches are destined to local human intake, these activities clearly yield substantial socioeconomic benefits. Artisanal fisheries play a key role in tropical coastal areas such as the Wider Caribbean Region (WCR), given the dependence of local communities on marine ecosystems as a source of high quality food and income generation (FAO, 2005); (Schuhmann, 2012); (Batista et al., 2014).

However, the socioeconomic relevance of artisanal fisheries remains poorly understood, and estimates as presented in National Accounts tend to under-represent their actual contribution to the local economies (Booth et al., 2006); (Batista et al., 2014). The fact that many seasonal or "occasional" fishers are often excluded from official statistics is one of the reasons (Batista et al., 2014). In addition, the downstream effects in the supply chain are difficult to estimate and thus, prone to be overlooked (FAO, 2005). Equally relevant, artisanal fisheries are usually characterized by decentralized post-harvest activities that undermine the data collection efforts (Charles et al., 2007). These factors cause policies to underestimate artisanal fisheries, and usually hinder any intentions to ensure their long-term sustainability (Barnes-Mauthe et al., 2013).

The Caribbean island of Montserrat is no exception to these issues. Montserrat counts with one of the smallest commercial fishing sectors in the Caribbean, practicing exclusively artisanal techniques (Ponteen, 2013). While fisheries current contribution to national Gross Domestic Product (GDP) amounts only to 0.3% (ECCB), the actual contribution may be higher given unreported fishing and flawed data collection (UCSB, 2015); (Lee, 2017); (observation, May 2017). Furthermore, fishing is a culturally relevant activity and an important source of food for domestic consumption, as well as of dynamism for downstream activities (UCSB, 2015); (Lee, 2017); (observation, May 2017).

Nevertheless, almost no information about the economic value of Montserrat´s fisheries is currently available. In this regard, further understanding is indispensable as a key input to any policy making process that could have an impact on the sector. It is also necessary if the livelihoods of those directly and indirectly dependent upon fishing activities are to be accounted for in that process.

Overall, considering (i) the various apparent socioeconomic benefits that commercial fisheries yield in Montserrat; (ii) the lack of estimates on the economic value created by the local fishing sector and (iii) the relevance of generating such information for local policy purposes, this study will pursue an economic valuation of the commercial fishing sector in Montserrat.

This study aims to answer the following question: *what is the current value added generated by commercial fishing in Montserrat?* To gain an insight into the indirect contribution of the commercial fisheries to the local economy, I also seek to answer the following question: *how much additional value is created when intermediate transactions occur before fish reaches the final consumer?* I address these questions by examining revenue and costs of the local commercial fishing fleet and local restaurants, mainly based upon primary quantitative data. These data are finally coupled with qualitative primary data to identify policy implications for the sector.

This paper is organized as follows. A theory background is presented in chapter 2 to outline the link between ecosystem services generated by fish resources, human welfare, and economic values. Chapter 3 reviews a representative selection of literature associated with fisheries valuation, with a focus in the WCR. Chapter 4 provides a detailed overview of the Montserratian commercial fishing sector. Chapter 5 describes the methods and data used to conduct this study, and chapter 6 presents and interprets the results. In chapter 7, discussion and policy implications derived from the results and additional data collected are exposed. Finally, chapter 8 acknowledges the limitations of this study and suggests lines for further research.

2. Theoretical background

2.1 Ecosystem services generated by fish stocks and their link with human welfare

Marine ecosystems offer numerous material and non-material benefits (i.e. goods and services) that are crucial for the wellbeing of humans (Daily et al. 1997); (Costanza, 1999). Relevant for the present study, Hammer and Holmlund (1999) review the role of fish stocks in generating ecosystem services. Without pretending to be exhaustive, I adapt their findings to the categorization by the Millennium Ecosystem Assessment (MEA, 2005) to provide a brief examination of the benefits that humans obtain from fish stocks.

Fish resources generate *regulating* services, since their consumption of organisms can impact the stability, resilience, and food web dynamics of aquatic environments. Removal of species with key characteristics can thus result in drastic changes for the ecosystems (Hammer and Holmlund, 1999). For example, Hughes (1994) found that human-induced loss of herbivorous and predatory fish species in Jamaican coral reefs was the main cause for a massive coral cover decrease between 1980 and 1993, shifting the ecosystem from a coral dominated to an algal dominated one. Considering that coral reefs are a significant source of seafood, recreational opportunities, coastal protection, and aesthetic and cultural benefits (Folke and Moberg, 1999), the decline of coral cover may negatively impact on human wellbeing.

Furthermore, fish stocks provide *supporting* services. Either through their movement patterns or as a food source for other aquatic, aerial, and terrestrial organisms, fishes act as both *active or passive transporters and distributors of energy and materials* (Hammer and Holmlund, p. 258) across spatial boundaries. The benefits of this are several. Fourqurean et al. (1991) showed that in eastern Florida Bay, nutrients from fishes consumed by seabirds are deposited along shores as feces. These stimulate the growth of seagrass meadows up to 200 meters away from bird colony sites. Being the primary habitat for larval pink shrimp, an important prey for fish, birds, and humans, the increase in seagrass meadows is of economic relevance for the area.

Fish resources are also a source of several *cultural* services. As pointed out by FAO (2012), recreational fishing (either for pleasure or competition) is one of the most popular recreational activities globally. In addition, fish populations and biodiversity in tropical reefs, lakes, and coastal areas also generate highly appreciated aesthetic services (Moyle and Moyle, 1995).

More evident, food *provisioning* in the form of commercial and/or subsistence harvest is among the most relevant services derived from all coastal and marine ecosystems (UNEP, 2006). In 2013, fish accounted for around 17% of the global population´s intake of animal protein, and 6.7% of all protein consumption. Beyond the direct benefits related to food security and nutrition, fisheries constitute a significant source of income generation and employment: FAO estimates that around 58.3 million people were involved in the primary sector of capture fisheries and aquaculture in 2012. When considering the extensive number of pre-harvest, harvest, and post-harvest activities the impacts are much larger (FAO, 2014); (FAO, 2016a). In the realization of these numerous benefits, artisanal fisheries play a fundamental role.

2.2 Artisanal fisheries and coastal communities

Following FAO (2016c, p.1), artisanal fisheries are "*traditional fisheries involving fishing households (as opposed to commercial companies), using relatively small amount of capital and energy, relatively small fishing vessels (if any), making short fishing trips, close to shore, mainly for local consumption. In practice, the definition varies between countries, e.g. from gleaning or a one-man canoe in poor developing countries, to more than 20-m. trawlers, seiners, or longliners in developed ones. Artisanal fisheries can be subsistence or commercial fisheries, providing for local consumption or export. They are sometimes referred to as small-scale fisheries.*"

The socioeconomic relevance of artisanal fisheries should not be overlooked: these are responsible for about 50% of global fish catches and 90% of the world´s capture fishers, and 90% to 95% of their landings are destined to domestic human intake. Artisanal fisheries play an especially key role in tropical coastal areas such as the Wider Caribbean Region (WCR), given the dependence of local communities on marine ecosystems as a source of nutritious food supply and income generation (FAO, 2005); (Schuhmann, 2012); (Batista et al., 2014).

Besides the direct impacts on income and employment of fishers themselves through the sales and own consumption of their catches, there are usually indirect upstream -investment and maintenance costs of vessels, engines, and gear; purchase of fuel, ice and bait- and downstream -fish cleaning, processing and marketing- impacts related to the harvesting activities that make an additional contribution to the local economies (FAO, 2005).

The cultural dimension of artisanal fisheries should be neither ignored. As indicated by Batista et al. (2014), in many coastal communities fishing is often an important component of cultural identity rather than a source of income of "last resort". In other words, fishing represents a way of life and embodies customs, values and traditions that are firmly rooted in local communities and transmitted between and within generations. This implies that the behaviour of artisanal fishers, for example in terms of when or where to fish and what species to catch are influenced by all socioeconomic, cultural and historical determinants. These dynamics add challenges to the already difficult task of fisheries management.

It has also been mentioned that artisanal fisheries are relatively more ecologically sustainable than large-scale and industrial fisheries. Reduced fuel costs due to shorter fishing trips and the use of more "passive" gear and practices (e.g. handlining, gillnets, fish traps), as well as lower bycatch and discards are some of the reasons behind that claim. Although, this does not mean that local fish stocks could not be overfished (FAO, 2016c).

Despite all of this, the true socioeconomic relevance of artisanal fisheries remains poorly understood, and estimates as presented in National Accounts tend under-represent their contribution to the local economies (Booth et al., 2006); (Batista et al., 2014). The lack of precise data and proper understanding causes domestic policies to underestimate artisanal fisheries, usually hindering any intentions to ensure their long-term development and sustainability (Barnes-Mauthe et al., 2013).

In this context, artisanal fishing activities are rarely subject to the support, attention and adequate investment by local governments (Marshood et al., 2008). This not only leaves local fishing communities exposed to the ongoing negative trends in terms of declining fish stocks, invasive species and degrading habitats, but also neglects the potential contribution that artisanal fisheries could make to food security, poverty alleviation and sustainable use of local marine resources (Charles et al., 2007) (Marshood et al., 2008); (FAO, 2011). At the same time, it stresses the relevance of understanding, assessing and managing fisheries properly (Charles et al., 2007).

2.3 Fisheries economics: a brief overview

Overall, human wellbeing, especially in fishing coastal communities, is closely linked to the ecosystem services that fish resources generate. Preserving marine ecosystems in a healthy state is crucial to ensure that the productivity of fish stocks and the socioeconomic benefits that humans derive from them, is secured for present and future generations (Agardy et al. 1995); (UNEP, 2006). As summarized by Norse (2010, p. 182), *if fisheries were well managed, fishes that were abundant and large still would be, and fishermen would have bountiful catches of desired fishes in waters near their homes.*

It cannot be ignored, however, that the management of ecosystems is an economic, social, and political problem that involves multiple trade-offs. Any use of ecosystems entails foregone benefits from potential alternative uses, and decision-makers need to strike a balance between them (van Beukering et al., 2015). For example, given the overlapping and competing interests of commercial and recreational fishing activities, imposing restrictions on the former may derive in gains for the latter (NAS, 2008). In addition, many of the services that nature provides are not easily observable and thus, may be overlooked by decision-makers. Without a clear understanding of the true value of natural resources, then decisions could be made that are *sub-optimal for a society as a whole* (van Beukering et al. 2015, p. 91).

Understanding and measuring the benefits described above, as well as the trade-offs inherent in any ecosystem-based management decisions, implies establishing a link between ecosystem services, human welfare, and economic value (Bockstael et al., 2000). In other words, it not only demands an understanding of the biophysical changes in ecosystem services that result from human activities, but also on the impacts these have on human wellbeing (Farber et al., 2006).

2.3.1 Defining human benefits and economic values

The economic value of an ecosystem good or service is related to the contribution it makes to human wellbeing; i.e. what it is worth to people (Bockstael et al., 2000). These economic values can be quantified by ascribing a monetary value to the benefits humans derive from ecosystems) is the domain of *economic valuation of ecosystem services*. As suggested above, the key to valuation is to determine the functions that ecosystems provide, and relate these to their societal values (van Beukering et al., 2015).

Economic values can be broadly classified into use and non-use values. Use values are related to those derived from actual or potential use of ecosystem goods and services, either directly or indirectly. Non-use values do not entail current or future use; instead, they are derived from the knowledge that an ecosystem exists and is preserved. The Total Economic Value (TEV) of an ecosystem can thus be determined by the aggregation of all the associated (use and non-use) values provided by that ecosystem (van Beukering et al., 2015).

Figure 1 outlines the parallels between ecosystem services generated by fish populations under the categorization of MEA (2005), as presented in section 2.1, and the standard categorization of economic values related to fisheries which may be considered to estimate their TEV.

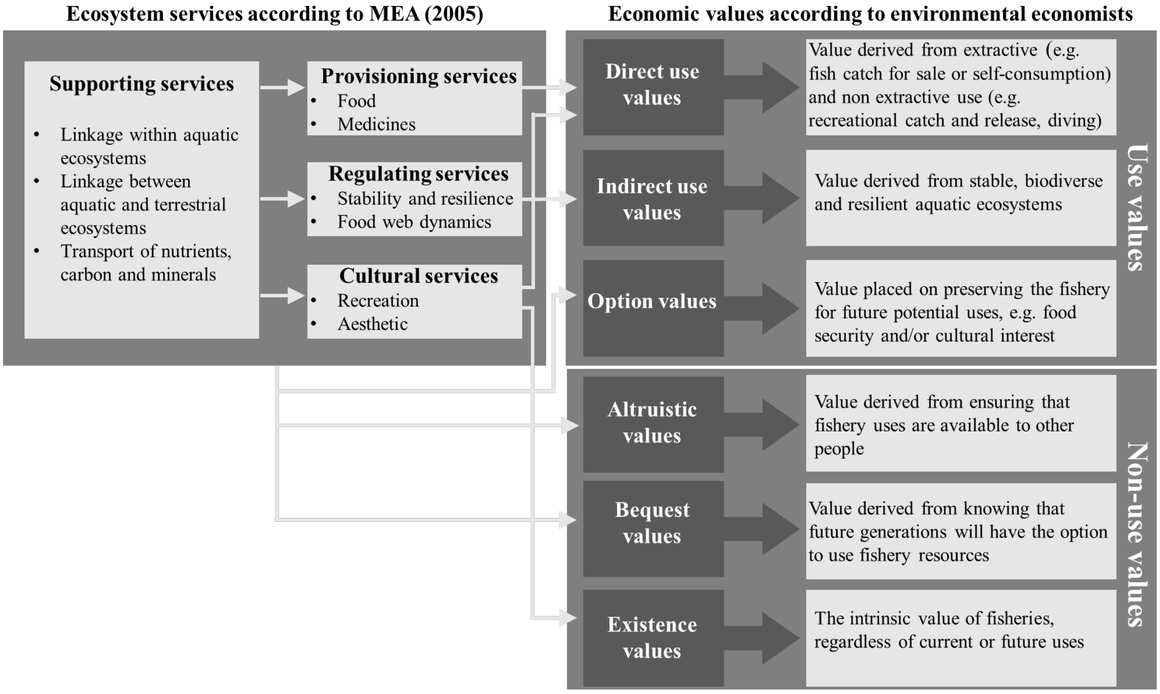


Figure 1. Parallel between ecosystem services generated by fish populations and their economic values. Source: own elaboration based on Hammer and Holmlund (1999), MEA (2005), Oxenford et al. (2010) and van Beukering et al. (2015)

As suggested in the figure above and following Oxenford et al. (2010), the economic value of fisheries goes beyond the marketplace, extending to non-marketed goods and services such as recreation and aesthetic values. In addition, the economic value of fish resources may not be necessarily associated with direct use. The values related to harvesting fish for consumption (marketed) or snorkelling (often non-marketed) are examples of use values, while the value that people obtain from knowing that the fishery exists, either for food supply, cultural relevance or for the wellbeing of future generations are examples of non-market and non-use values.

2.3.2 Measuring values

Following Costanza et al. (1997), ecosystem services valuation implies an understanding of how changes in the supply of environmental goods and services affect human welfare. In other words, any changes in the provision of ecosystem services, either in terms of quality or quantity, positively or negatively, have value inasmuch as they affect the human benefits. Note that these variations in ecosystem services provision may impact human wellbeing through established markets, but also through non-market activities. For instance, changes in coral reef quality or quantity that affect fish populations may be observable in commercial fish markets. On the other hand, cultural services derived from the coral reefs could instead not be easily noticeable in markets.

Economic valuation may quantify economic values by observing people´s actual market behavior and the amount of money they pay to obtain a specific good or service. When such information cannot be noticed in actual markets, values may be derived by defining either how much people are willing to pay (WTP) for beneficial changes, or how much they are willing to accept (WTA) to be compensated for non-beneficial changes in the provision level of ecosystem services (Bockstael et al. 2000); (Barbier et al. 2011); (van Beukering et al., 2015).

Overall, this information constitutes a necessary input to estimate the total value that can be attributed to an ecosystem service. Based on van Beukering et al. (2007), the total value attributable to an ecosystem service can be measured as the total welfare it creates, and equals the sum of the producer surplus and the consumer surplus. The producer surplus is a measure of the producer welfare, and can be defined as the difference between the price a producer of a good or service receives and the minimum price he is willing to accept for it (i.e. the marginal production cost). The consumer surplus is a measure of the consumer welfare, and is the difference between the maximum price consumers are willing to pay and the actual price they pay.

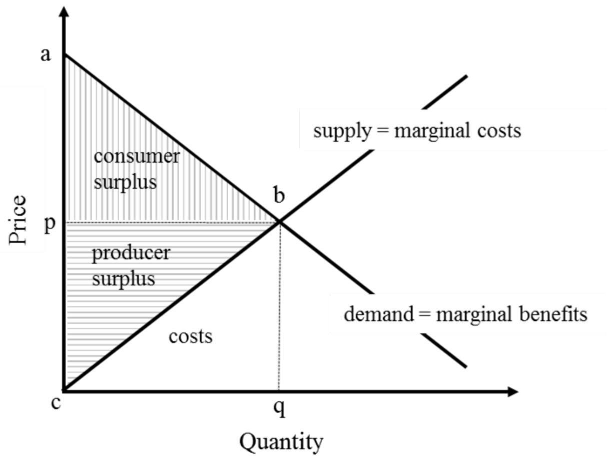


Figure 2. Supply and demand curves for a typical good or service, showing the definitions of cost, producer surplus and consumer surplus. Source: own elaboration based on Costanza et al. (1997)

Figure 2 shows these concepts graphically. It depicts the conventional supply (marginal costs) and demand (marginal benefits) curves for a typical good or service. The cost of production is represented by the area below the supply curve, *cbq.* The "producer surplus" or "net rent" is the area between the market price and the supply curve, *pbc*. The "consumer surplus" is the area between the demand curve and the market price, *abp*. The TEV created in and industry that can be attributed to the natural resources, is the sum of the producer and consumer surplus, the area *abc*. (Costanza et al. 1997).

As inferred from above, producer surplus may be relatively easy to monetize, since it can be related to the amount of revenue that is kept after paying for all the costs incurred in the production of a certain good or service. In the valuation of ecosystem services, the producer surplus must be considered if there are costs related to "producing" the ecosystem good or service (Freeman, 1993); (de Boer et al., 1998). For example, in the case of fish stocks as a source of food, these costs relate to those incurred by fishermen to carry their harvesting activities. With respect to consumer surplus its estimation is not as straightforward, since demand curves for any goods in general and for ecosystem services in particular, are very difficult (when not impossible) to estimate in practice (Costanza et al., 1997).

Sometimes, "economic impact models" are used either as a substitute or complement to valuation tools (see chapter 3). These models often trace the flow of transactions that occur through an economy and measure the economic impact of the activity by the rounds of spending created by a change in final demand (FAO, 2016b). In the fishery case, for instance, fish catches serve as inputs into the production and sale of fish meals by restaurants and thus, additional value is created as landings move through the supply chain to the final consumers (Oxenford et al., 2010).

These impacts may be expressed under several ways, including total output, value added and employment, and are often partitioned into *direct*, *indirect*, and *induced* effects[1]. Note that gross value added may be a relatively close approximation to producer surplus or economic profit, but one that still overestimates the actual producer surplus (FAO, 2016b). As defined in the European system of accounts (EC, 2010), gross value added (GVA) equals the difference between an industry's output value and the cost of its intermediate inputs (including energy, raw materials, semi-finished goods, and services that are purchased from all sources). In other words, the components of GVA consist of compensation of employees; taxes on production and imports less subsidies and gross operating surplus[2], and thus, exceeds the concept of producer surplus. By subtracting consumption of fixed capital (i.e. depreciation) from GVA, net value added (NVA) is derived (EC, 2010).

2.3.3 Approaches to economic valuation

In practice, approaches to ecosystem services valuation can take many forms, depending on what is being valued and what is the policy purpose of the values (Schuhmann, 2012). While Figure 3 summarizes the methods that are more generally used for the valuation of ecosystem services, it goes beyond the aim of this sub-section to describe all of them. On the contrary, special focus is put on those approaches that are particularly relevant for the valuation of commercial and subsistence fisheries, while a concise insight into recreational fisheries valuation is also given.

As indicated by Schuhmann (2012) and FAO (2016b), when values are easily noticeable through market transactions, such as benefits associated with direct extractive uses, monetization can be achieved through the market price (MP) approach. Often referred to as financial analysis, in its simplest form this method estimates total expenditures by purchasers (equal to revenue received by producers) based on market prices and quantities. These estimates alone, however, ignore the costs of providing the goods and services and do therefore not express the net economic gains to market participants. As such, they may not be an accurate measure of actual economic value as outlined in previous sub-section.

[1] As indicated by Oxenford et al. (2010, p. 3), the *direct* effect is the contribution of the fishing industry itself to the national economy, the *indirect* efect is the economic impact on suppliers of inputs used in the industry and the *induced* effect is the economic impact of spending by households as income is generated due to *direct* and *indirect* effects.
[2] Following EC (2010), Gross operating surplus represents the excess amount of money generated by an activity after paying for labor costs, but before accounting for consumption of fixed capital (i.e. depreciation costs).

Valuation method			Approach	Applications	Limitations
Market valuation methods	Direct	*Market prices*	Observe prices and quantities directly in markets	Marketable goods and services	Prices may be distorted (e.g. subsides); many environmental services are not traded in markets
		Net factor income	Revenue from sales of goods or services minus costs of other inputs	Resources that provide an input in the production of a marketed good	Potential over-estimates of economic values
		Production function	Estimate value of ecosystem service as input in production of a marketed good	Resources that provide an input in the production of a marketed good	Technically difficult; high data requirements
		Cost-based methods	Estimate values based on the costs of avoding damages due to lost services; the cost of replacing environmental assets or the costs of providing substitute services	Ecosystems that provide protection; ecosystems that have a man-made equivalent that could be used to provide similar benefits	May provide with understated and inconsistent measures of economic value; often difficult to find exact replacements for ecosystem services
	Indirect	*Hedonic pricing*	Estimate the influence of environmental characteristics on price of marketed goods	Environmental characteristics that vary across goods (e.g. houses)	Technically difficult; high data requirements
		Travel-cost	Estimate values based on travel costs to access a resource	Mainly recreation sites	Technically difficult; high data requirements
Non-market valuation methods		*Contingent valuation*	Ask survey respondents directly for their WTP for an environmental service	Any environmental goods or services	Expensive to implement
		Choice experiments	Ask survey respondents to trade-off environmental and other goods to reveal WTP	Any environmental goods or services	Expensive to implement; technically difficult
Other methods		*Value transfer*	Use values estimated at other locations	Any environmental goods or services	Possible transfer errors; (may be) technically difficult
		Meta analysis	Summarize, synthetize and analize the available empirical evidence on certain ecosystem service values	Any environmental goods or services	Time consuming; dependent on availability of empirical evidence, may neglect case study-specific features

Figure 3. Valuation methods: typical approaches, applications and limitations. Source: own elaboration based on van Beukering et al. (2007) and van Beukering et al. (2015)

When more detailed data on costs and revenue are available, calculations can go beyond to estimate the producer surplus or net rent. Taking the MP approach to this level is often referred to as the net factor income method (van Beukering et al., 2006). As pointed out by van Beukering et al. (2007), this approach estimates the value of ecosystem services as an input in the production of a marketed good. The estimate is related to the difference between the revenue and the cost of other inputs in production. For example, in the context of a small island, the value of fish populations in supporting commercial fishing activities should be estimated as the revenue received by fishermen from their sales minus the costs incurred for carrying out their activity. It is important to keep in mind that when a portion of the catch is kept for own consumption, no "actual" revenue can be observed. Using market prices as a proxy for the value of these catches is a practical approach to solve this issue.

An alternative (and perhaps the most desirable) approach to estimate the value of commercial fisheries is the production function method (van Beukering et al., 2011); (Schuhmann, 2012). This method describes how a change in the availability of an ecosystem input may result in a change in total output and/or the use of other inputs (van Beukering et al., 2015). For example, a reduction in the availability of fish stocks of a given marine ecosystem may result in either a decrease in the fish catches or in an increase in fishing efforts for a given quantity of catches. In any case, fishermen would suffer an economic loss. By estimating the change in the producer surplus (i.e. the difference between revenue and costs of fishermen) after a change in ecosystem input (i.e. fish stocks), the value of that input can be observed.

The technical complexities and high data requirements associated with the production function method make it difficult to apply. As such, it may be less relevant in some contexts such as small islands, unless the expertise and data are available (van Beukering et al., 2007). As it will be evident from the literature review in chapter 3, the MP and net factor income methods offer a simpler way of estimating the value of commercial fisheries and therefore, are the most commonly used approaches.

Valuation of recreational fishing requires alternative methods to those outlined for commercial or subsistence fishing. The reason is that enjoyment or pleasure benefits are non-marketed goods and as such, their value cannot be derived from direct market prices (van Beukering et al., 2015).

Revealed preference methods are based on actual behavior to uncover these values in *complementary or surrogate markets* (van Beukering et al. 2015, p. 109). The travel cost method, for example, would look at an angler´s travel cost as estimated by his round-trip travel distance to a certain fishing location to derive the implicit value of that recreation site (FAO, 2016b). On the other hand, stated preference methods base on hypothetical behavior to derive economic values. Applied to recreational fishing, the CVM would rely on asking fishermen how much they would be willing to pay (or to accept) for an increase (decrease) in recreational catches (FAO, 2016b). The responses can then be analyzed to estimate the average value that fishermen associate with the proposed change and thus, to recreational catches. The CEM is comparable to the CVM in the sense that values are also inferred from hypothetical situations. However, the approach is different, since respondents are asked to select between a set of alternatives instead of directly revealing values (van Beukering et al., 2015).

In the present document, I only examine those direct and extractive use values that are associated with market transactions corresponding to commercial fishing activities in Montserrat. My analysis of value is based on the net factor income approach and includes an examination of revenue and costs of the Montserratian commercial fishing fleet. Considering that commercial fishermen do not incur labor costs and their production is not taxed, the concepts of NVA and producer surplus can be used interchangeably in our case study. Thus, by estimating NVA and hence producer surplus of the activity, I am carrying a partial valuation of the ecosystem services generated by fish populations in Montserrat. In the same line, by outlining how much the value of fish increases as this moves with downstream transactions, I can gain insight into the indirect contribution of the commercial fisheries to the local economy.

Overall, my estimates constitute a first step towards a broad understanding of the welfare created in the fishing industry on Montserrat. Note that a total valuation should also consider consumer surplus as well as non-market and non-use values derived from Montserrat´s fisheries. While this goes much beyond the scope of our study, it is also an interesting line for future research.

3. Literature review

Studies within the valuation of marine ecosystems services domain were reviewed by Schuhmann (2012) for the WCR, the geographical context of relevance for our study. In connection with the valuation efforts devoted to fisheries, approaches and findings logically differ depending on the study areas, the data availability and, above all, the type of values to be estimated. Hereinafter, I provide a brief overview of a representative portion of literature associated with fisheries valuation in the WCR.

Burke et al. (2011) estimated the economic contribution (in terms of gross revenue) of Jamaica´s coral reef-related commercial and subsistence fisheries for the period 2001-2005. The authors found that together, commercial and subsistence fisheries were worth around USD 34.3 million per year, or 0.3% of Jamaica´s annual GDP. Also for the case of Jamaica but with a focus on Montego Bay Marine Park, Gustavson (1998) combined a net factor income approach and a production function model to estimate the net present value (NPV) of the coral reefs associated with tourism, coastal protection and (nearshore and largely subsistence) fishing. The estimated NPV associated with fishing were found to range from USD 1.66 to USD 7.49 million at constant prices of 1996, depending on the discount rate assumed.

For the case of Tobago and St. Lucia and in terms of reef-associated fisheries, Burke et al. (2008) focused on commercial fisheries, fish processing industries and local fishing, the latter referring to the values derived from local subsistence and recreation. With respect to commercial fisheries (production and processing), and by means of the net factor income approach, the annual direct economic impact of coral-reef associated fisheries was estimated to range from USD 640,000 to USD 913,000 in Tobago, and from USD 437,000 to USD 656,000 in St. Lucia. At the same time, the authors estimated the additional indirect impacts generated both through the production of equipment needed to fish, as well as through the additional revenue generated through the *fisheries economy multiplier*[3]. Estimates were found to range between USD 118,000 and USD 235,000 and from USD 82,000 to USD 185,000 for Trinidad and St. Lucia, respectively. Finally, local subsistence and recreational fishing in St. Lucia was valued at between USD 155,000 and USD 790,000 (no estimate was presented for Tobago).

Using a similar approach, Burke et al. (2009) estimated the economic contribution in terms of gross revenue of reef and mangrove associated commercial fisheries in Belize. This was found to fall between USD 14.2 and USD 15.9 million per year. Using data on taxes from marine recreation and revenue from accommodation and other tourist spending, the value of sports (recreational) fishing was estimated to range from USD 7.2 to USD 8.5 million per year.

Oxenford et al. (2010) estimated the economic contributions of the Barbados longline fisheries to the national economy, as part of a broader project on the “Economic valuation of the fisheries of Barbados”. The study examined only the values associated with direct and indirect market transactions and included an analysis of vessel-level revenue, costs, and profitability, as well as indirect, induced, and value-added market effects generated by the fisheries. In brief, the total economic impact (including estimates of output, income and value added) of the longline fisheries was found to lie between USD 3.45 and USD 5.3 million.

Also with an insight into Barbados, Johnson et al. (2007) calculated the additional value that is created with each transaction as fish moves through the different market pathways. By determining the pathways along which fish move from fisher to consumer and the price increase at each step, the total additional value was estimated to average USD 19 million; about 2.6 times the landed value of the fishery. Bearing these results in mind, the authors highlighted the importance of valuing fishery products broadly to gain better understanding on their real contribution to the local livelihoods.

Van Beukering et al. (2010) estimated the value of commercial and recreational fisheries as part of a broader study examining the TEV of Bermuda´s coral reefs. The final net values of the commercial reef-associated catch, for both finfish and lobster, was calculated to be approximately from USD 600,000 to USD 1.8 million, based on a 20% to 60% profit margin. The total value of recreational reef-associated fisheries in 2007, assessed by means of a (400) households survey, was estimated to be USD 3.7 million. A similar study was carried by van Beukering et al. (2011) for the United States Virgin Islands (USVI). Using the net factor income approach, reef associated commercial fisheries were estimated to be worth approximately USD 1.4 million annually. For the case of recreational fisheries, CVM was used to determine the WTP of recreational fishers to avoid a 20% loss in fish catch. Drawing on this, the value of recreational fishing was estimated at around USD 1.85 million per year.

[3] Defined by the authors as the *additional revenue generated as the money spent by fishermen spreads through the economy*. (p. 34).

In the same line, but with a focus on the coral reefs in Bonaire, van Beukering et al. (2012) estimated the economic value of commercial, subsistence and recreational fishing, combining the first two given the difficulties found to distinguish them. Using the net factor income approach, the reef-related total commercial fisheries were valued at around USD 400,000 annually. Alternatively, by means of both the CEM and the market valuation method, the recreational fishery value was estimated at around USD 700,000 per year.

To the best of my knowledge, no other study has pursued an economic valuation of fisheries of any kind for the case of Montserrat. This study contributes to filling in that void.

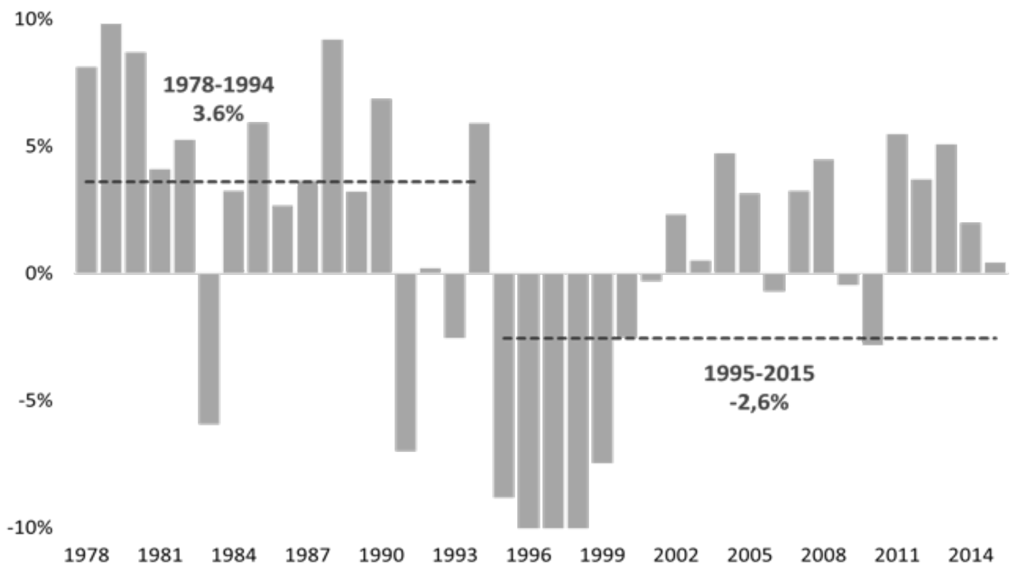
4. Montserrat background

4.1 General overview

Montserrat is a small volcanic island located in the northeastern Caribbean Sea. It forms part of the Leeward Islands, which make up the northern part of the Lesser Antilles, in the British West Indies. It is a British Overseas Territory (BOT) and includes 102 km^2 of land area and 45 km of coastline (UCSB, 2015).

Several natural disasters have disrupted the island´s ecosystems, demographics, and economy over recent decades. While in 1989 hurricane Hugo caused significant damages to infrastructure and coastal environment, the largest natural disaster has been the repeated eruptions of the Soufriere Hills volcano between 1995 and 2010. The onset and continuing volcanic activity destroyed the capital city of Plymouth and numerous smaller villages, and around two-thirds of the island´s surface was designated as exclusion zone with restricted or even prohibited access. Because of these natural disasters many residents were forced to leave the island, and the population declined from 11,900 in 1990 to 4,922 in 2011, with present residents inhabiting only the west coast and the northern sections of the island (UCSB, 2015).

Volcanic activity has also affected the local economy. Between 1995 and 2015, the economic activity declined at an average rate of 2.6%, contrasting with the average growth rate of 3.6% registered between 1978 and 1994. Currently, the economy heavily relies on the *Public Administration* sector, which together with *Real Estate and Business activities*, contribute to around 50% of GDP (ECCB).



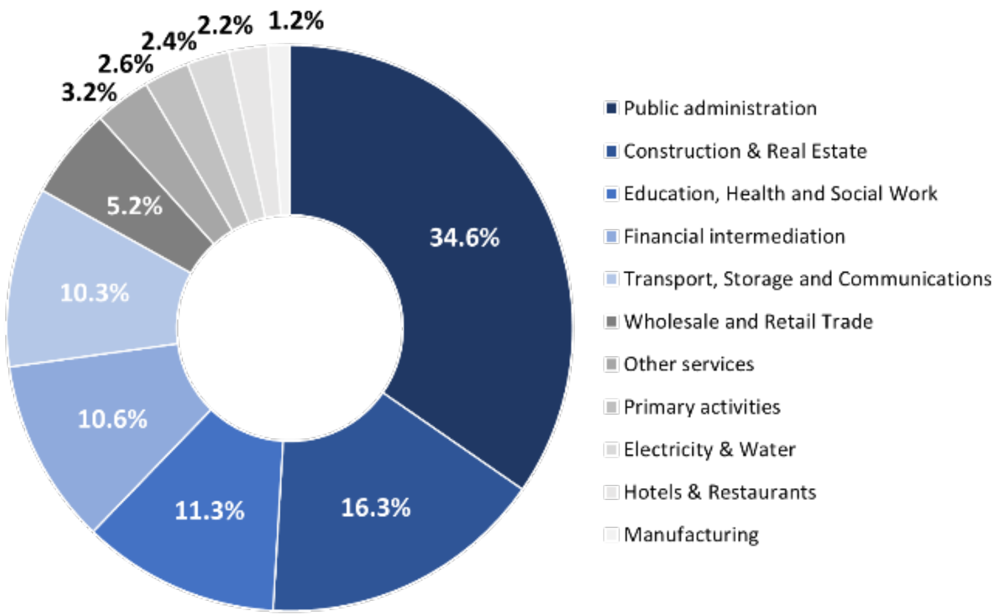


*Figure 4. **Top**: Montserrat GDP 1978-2015 (annual real growth); **Bottom:** contribution to GDP by economic activity (2015, share in total). Source: own elaboration based on Eastern Caribbean Central Bank statistics (ECCB)*

4.2 Fisheries sector overview

Montserrat has one of the smallest fishing sectors in the Caribbean, practicing exclusively artisanal techniques (Ponteen, 2013). While the reported contribution of the fishing industry to national GDP amounts only to 0.3% (ECCB), the actual contribution may be higher given unreported fishing, flawed data collection and downstream effects (UCSB, 2015); (Lee, 2017); (observation, May 2017). To the purpose of this study, it is of interest to provide a detailed overview of the sector. This includes background information about individuals involved in commercial boat fishing, fishing vessels and gears used (sub-section 4.2.1) and infrastructure, marketing, and fish imports (sub-section 4.2.2) related to the sector. Unless otherwise stated, the content of this section is based on own observations and personal communications with 18 commercial boat owners or captains and the director of the Fisheries Unit (Mr. Ponteen), among others, all held during a four-week visit to the island in May 2017. Further details on the data collection methods are provided in chapter 5.

4.2.1 Fishermen, fishing fleet and gears

There are no official records of the total number of commercial and recreational fishermen on island. The Fisheries Unit has only recently began a vessel registration and fishing licensing procedure by handing in forms to comply with the Articles 9 (1) and 14 (1) of the Fisheries Act 2013 (GOM, 2013), which state that *no fishing vessel shall be used for fishing or related activities in the fishery waters unless there is in existence in relation to that vessel a valid certificate of registration* (p.11) and that *notwithstanding the existence of a certificate of registration in respect of a fishing vessel, no person shall use that fishing vessel or any other vessel, craft or vehicle for fishing or related activities in the fishery waters unless he applies for and obtains a fishing license* (p.13).

The lack of official estimates on the total number of fishermen on the island is a major constrain to any analysis about the sector. In connection with commercial fishing, there are currently 21 vessels that go fishing regularly and are monitored by the Fisheries Unit for data collection purposes. These vessels are operated by 2.4 crew members on average, including the boat owner or captain.

The average age of commercial boat owners is 52-year-old, with only two of them reporting to be under 30 and six of them above 60. Among these and following the categories used by FAO[4], approximately 40% are *full-time* fishers, 40% are *part-time* and 20% are *occasional* fishers. All of them are male. Civil servant, fire officer, forest ranger, port surveillor, gardening and carpentry are some of the professions or activities mentioned by those not being *full-time* fishers. In those cases, although fishing may provide with substantial income, its unpredictability due to weather and other external factors are the reasons forcing them to have other occupations.

While generating financial income is the main reason to get involved in fishing activities, harvesting for own consumption and enjoyment are two (equally relevant) secondary reasons. In this regard, all fishermen report to keep some portion of their catch for own consumption. On average, around 85% of the total catch is sold while the remaining 15% is kept for domestic intake after every trip. The recreational and cultural component of fishing is also evident, even if this is mainly done for income purposes. The activity is rooted in fishermen lifestyle, customs and values. In fact, half of the individuals declared to be involved in fishing activities since "having memory", with the knowledge transmitted to them from older generations. In addition, those fishermen that have additional sources of income

[4] According to FAO (2002), *Full-time fishers receive at least 90% of their livelihood from fishing or spend at least 90% of their working time in that occupation*; *Part-time fishers receive at least 30% but less than 90% of their livelihood from fishing or spend at least 30% but less than 90% of their working time in that occupation* and *Occasional fishers receive under 30% of their livelihood from fishing, or spend under 30% of their working time in that occupation.*

claimed they would only fish if they could be sure of making a living out of it. Comments such as *"fishing is my life"* or *"I will never retire from fishing"* were often heard in personal conversations, stressing the cultural value of the activity.

The fishing vessels are made of wood and/or fiberglass, and their length ranges from 4.5 to 10.5 meters. In all cases they are motorized with at least one outboard gasoline engine, with an average 76 horsepower. 70% of these vessels were purchased abroad (either brand new or second hand) or locally (only second hand), while the remaining 30% were artisanally fabricated by the owners or other individuals on island.

Trinidad and Antigua are the main countries of origin for the vessels and engines that were imported, respectively. The United States, United Kingdom, St. Maarten and St. Kitts are additional countries that were mentioned by boat owners. Boats and engines average nine and four years since purchase, respectively. With the exception of one only individual, all boats and engines were reported to be fully paid. These are in all cases the property of one only person, who takes active part in every fishing trip and engages in marketing and equipment repair as well. In fact, almost 80% of the boat owners claimed to maintain, paint and repair the boat structures alone or with their crew when needed, while 50% would also repair or service their engines. None of the fishermen reported to have any insurance for their fishing vessels.

According to the boat owners/captains responses, fishing trips take place only once a day and their duration can range from 4 to 14 hours depending on the catch, weather and sea conditions. On average, vessels go fishing three days a week, although this also varies with the external factors mentioned before. Almost all fishermen claimed to go fishing on Saturdays and Sundays, and those having additional occupations highlighted they would also do it on days off or after finishing their workday.

Only two out of 18 boat owners pay (with money) to their crew. In most of the cases crew are not paid, but allowed to go fishing in the boat and retain their own catch. In return, in half of the sampled vessels the crew contributes to pay for the operational costs (fuel, ice, and bait) and these are shared evenly with the boat owner. In the other half, the boat owners reported to bear all these costs by themselves. With respect to the distribution of the catch, only in five vessels the overall catch is put together, sold and the revenue distributed evenly afterwards. On the contrary, in most of the cases each fisherman on the boat retains and sells his own catch.

Among the surveyed fishing vessels, 16 of them target mainly reef fish and the remaining two target instead coastal pelagic (CP) species. However, among those targeting reef fish, some would also target CP species or ocean pelagic (OP) species as well[5]. Handlines and fishing pots are the most common gears to catch reef species: 12 out of the 16 vessels targeting reef fish use one or both types of gears.

[5] Following the NOAA fisheries glossary (NOAA, 2006), reef fish *live mostly on or around reefs* (p. 40); coastal pelagic fish refers to *fish not associated with the ocean bottom that migrate in coastal waters* (p.6) and ocean pelagic fish to *fish that live in the open ocean at or near the water´s surface and usually migrate long distances* (p. 35).

There are on average 25 pots per boat, and these are usually left soaking for around eight days until they are hauled up. Very often fishers build their own pots, although in some cases they pay other fishermen on island. Other gears used for targeting reef fish are bottom longlines and spearguns. In connection with CP species, only two boats fish with beach seine nets. Gill nets are more common, and six boats use them, with an average soak time of four hours. Finally, large OP species are mainly targeted with handlines and fishing rods, usually by means of trolling.

Given the absence of fishing equipment stores in Montserrat, gears have to be purchased abroad. Even when making their handlines and pots, almost all fishers purchase the materials needed in neighboring islands. In most of the cases they travel to Antigua by ferry, while in some others (mainly the younger ones) equipment is ordered online from the United States and China. Thus, individuals need to incur either in traveling or shipping costs and customs cost. Note that fishers can and some of them do apply for duty free concessions to obtain a significant reduction of the customs cost. However, many find this a very intricate process and usually prescind from that benefit.

4.2.2 Infrastructure, marketing and fish imports

Montserrat does not count with a fishing harbour, and the ferry terminal in Little Bay (located in the north of the island) is used as the main fish landing site. Because the ramp used by the fishing vessels is located next to the ferry site, fishers need to take into account the departure and arrival times of the ferry to avoid accidents or inconvenient when going or coming back from the sea. In addition to the ramp, there is a crane facility for hauling and launching boats (a service that fishermen need to pay for) and a group of small stalls located next to the public market, where a few fishers pay a monthly rent to make use of freezers and store their fish. Montserrat does not have any storage facilities where boats can be kept, maintained and repaired. This implies that many fishers need to store their boats in their homes, in an outdoor space located next to the ferry terminal, or simply leave them anchored in Little Bay.

The island does neither count with a marketplace where fish is handled, cleaned, kept cool and offered to the public for sale. For this reason, some fishermen have pre-agreements with private households or restaurants to bring them their catch. Some others use pick-up trucks and park in the roadsides of Little Bay and Carr´s Bay, weighing and selling the fish directly from the trucks boxes. Because many customers prefer to have their fish cleaned after purchase (fishermen usually sell it whole), a group of people in Carr´s Bay Beach and at least one more person based in the public market clean fish for around XCD [6] 4.4 per kg (XCD 2 per pound).

[6] The XCD is pegged to the USD at a fixed rate of XCD 2.7 to USD 1.

Figure 5. Northwest of Montserrat: main infrastructure and marketing locations. Source: own elaboration based on Google Maps.

As pointed out by Ponteen (2013), Montserrat´s fish production is not enough to satisfy local demand. Thus, large quantities of frozen, dried, processed, and canned fish are imported every year. According to the data provided by the Statistics Department, fish imports amounted to 66,278 kg (146,117 lbs.) at a customs value of XCD 1,081,982 in 2016. Note that the total catch recorded by the Fisheries Unit during the referred year was around 27,373 kg (60,348 lbs.). Thus, according to the official statistics, Montserrat is currently importing approximately 70% of its fish demand.

5. Materials, methods and data

5.1 Methods

To investigate the commercial fisheries valuation, both secondary and primary data were employed. On the one hand, a database prepared by the Fisheries Unit that corresponds to 2016 was used. This includes records of 483 fishing trips made by 21 boats along 269 days. It contains information on dates, landing site, vessel names, catch (disaggregated by species), and main gear type used in each trip.

Two data collectors are in charge of gathering landings and fishing efforts data as well as gear types used by the commercial vessels, from Monday to Friday between 8 A.M. and 4 P.M. Data collectors do not record data directly upon landing in the Little Bay ferry terminal; this is done when fishermen drive by the site where the Fisheries Unit office is located, around 700 meters away from landing. Given that several restaurants are located within both sites, some of the catch has usually been sold by the time that data collectors approach fishers. In addition, several fishing trips take place or are finished after 4 P.M.

during the weekdays and/or occur during weekends; i.e., outside data collectors working hours. Although some fishermen acknowledged to keep their own records and forward them to data collectors when these cannot collect the information themselves, they may not necessarily do it always, while the other fishermen never do it at all.

The responses collected through personal interviews with local fishermen suggest that only 50% of the trips may be currently recorded. In any case, while the degree is difficult to determine, this implies that the data recorded by the Fisheries Unit does not represent the total commercial catch, but a substantial underestimation.

The fisheries database was furthermore complemented with primary data, collected through semi-structured face-to-face interviews with 18 boat owners and captains (Appendix A) during a four-week visit to Montserrat in May 2017. The duration of these interviews averaged 20 minutes, depending on the context in which they were held and the willingness to cooperate of the interviewees.

A typical interview started with a general introduction about the reason of the visit to the island and the motivations behind the project. The study was welcomed by most of the fishermen, who acknowledged the importance of improving the estimates related to their activity and were willing to share their personal information. In only a few cases interviewees complained that similar questions had been asked before with no accounted benefits to them. However, these fishermen were still encouraged to provide their opinions and while the quality of these responses may have been lower than the average, they were still useful for the analysis.

The main objective of these interviews was to resolve data gaps associated with fishing costs. Data on investment and maintenance costs of vessels and engines; variable costs of fuel, ice, and bait and replacement costs of gears were collected. Additional background information (already described in chapter 4) as well as opinions, main concerns and necessities of fishermen that could be relevant for policy implications were gathered.

Interviews with the owners or captains of 18 out of the 21 boats that are currently monitored by the Fisheries Unit were carried (henceforth *sampled* vessels). The three remaining boats could not be sampled since their owners were abroad during the visit to the island. Relevantly, while these 18 boats are being monitored in 2017, only 13 of them were also monitored in 2016 and are included in the official database (henceforth *sampled and monitored* vessels). In personal communication, Mr. Ponteen informed that the remaining eight boats of the 2016 database are no longer active or have reduced their operations significantly. The data gap corresponding to these missing boats (henceforth *non-sampled* vessels) was filled using median responses of *sampled* boats. Note that given the presence of large outliers in our sample (see section 5.2), the median was considered more reliable than the mean as a measure of central tendency (Agarwal, 2006).

Complementary data collection was carried out to support the present study. This included daily conversations with Mr. Ponteen, numerous communications with crew members and other individuals involved in the fishing industry, and the attendance to a three-hour meeting between a group of fishermen and Mr. Ponteen. Several visits to the main fish landing site in Little Bay and observations of the tour made by fishermen after unloading their catch were also carried out.

As introduced in chapter 2, fish catches serve as inputs into the production and sale of fish meals by restaurants and thus, additional value is created with downstream operations. To gain further insight into this issue, ten and four semi-structured face-to-face interviews with restaurants owners and fish cleaners, respectively, were carried out (see Appendixes C and D). Interviews with restaurants owners enabled to collect data on their costs structures, necessary to estimate the value added of their activities. Complementary information on the amount of local and imported fish purchases, types of species demanded and average prices paid were also collected. Overall, these interviews provided a broader understanding of the fishing sector and how changes in the harvesting stage could affect downstream operations. The data collected from fish cleaners served in a similar way.

5.2 Data description and analysis

As referred before, the information collected from the *sampled* vessels was used to resolve data gaps related to **fixed capital**, **variable costs** (fuel, ice, and bait) and **mixed costs** (maintenance and gear replacement) of the commercial fleet. This data was coupled with **gross revenue** estimates, derived from official catch recordings and market prices, to estimate GVA and NVA of commercial fisheries. Sub-section 5.2.1 describes the primary data, while sub-section 5.2.2 outlines the approach used to arrive at the value-added estimates.

5.2.1 Catch, market prices and fishing costs

According to the official database, 27,373 kg (60,348 lbs.) of fish were landed in 2016. Of these, 13,903 kg (30,651 lbs.) corresponded to reef species, with queen triggerfish (*Balistes vetula*), blue tang (*Acanthurus coeruleus*), doctorfish tang (*Acanthurus chirurgus*) and red hind (*Epinephelus guttatus*) being the dominant species. CP landings, primarily needlefish (*Belonidae*), accounted for 12,518 kg (27,598 lbs). Finally, OP catch, mainly wahoo (*Acanthocybium solandri*), dolphinfish (*Coryphaena hippurus*) and yellowfin tuna (*Thunnus albacares*), reached 952 kg (2,099 lbs.). Market prices have remained stable at XCD 22 per kg (XCD 10 per lb.) of reef and OP species, and XCD 17.6 (XCD 8) per kg (lb.) of CP species in the last years. Descriptive statistics for the **fixed capital costs** (i.e. investment costs) and additional information of the fishing vessels are reported in Table 1.

Table 1. Fixed capital costs and characteristics of Montserratian commercial fishing fleet

Variables	N	Mean	Median	Std. Dev.	Min	Max
Vessel cost (XCD)	**17.0**	**35,235**	**20,000**	**40,516**	**6,000**	**180,000**
Ownership (years)	17.0	8.9	6.0	6.8	0.7	20.0
Length (feet)	18.0	22.9	22.0	5.1	15.0	35.0
Engine N°1 cost (XCD)	**16.0**	**13,844**	**11,000**	**8,648**	**3,000**	**26,000**
Engine N°1 ownership (years)	18.0	4.4	4.3	3.2	0.2	12.0
Engine N°1 size (horsepower)	18.0	75.7	55.0	56.9	25.0	250.0
Engine N°2 cost (XCD)	**6.0**	**13,700**	**13,750**	**9,974**	**2,700**	**25,000**
Engine N°2 ownership (years)	7.0	3.5	2.0	3.4	0.2	10.0
Engine N°2 size (horsepower)	7.0	75.7	50.0	81.4	15.0	250.0

Note: "N" denotes number of responses; "Std. Dev.", Standard Deviation; "Min", minimum reported value and "Max", maximum reported value.

Source: own elaboration based on primary data

The dominant fixed capital cost is the investment on the fishing vessel. The average price paid for vessels was XCD 35,235, ranging from XCD 6,000 to XCD 180,000, with a median value of XCD 20,000. The reported maximum and the second largest value (XCD 70,000) constitute two outliers that explain the large difference between the mean and the median. In fact, when removing these two values from the sample, the mean equals XCD 23,267. All vessels are equipped with at least one outboard fuel engine, with a mean cost of XCD 13,844 and a median value of XCD 11,000. Seven vessels have one additional engine.

Variable costs are those regular costs that vary with fishing efforts or catch (Pascoe et al., 2015). For the case of Montserrat these refer to fuel, ice, and bait expenditures. Descriptive statistics for these costs are presented in Table 2.

Table 2. Variable costs of Montserratian commercial fishing fleet (XCD)

Variables	N	Mean	Median	Std. Dev.	Min	Max
Fuel cost per trip	18.0	147	112	142	56	675
Ice cost per trip	14.0	24	17	25	6	88
Bait cost per trip	14.0	93	96	37	44	150

Note: "N" denotes number of responses; "Std. Dev.", Standard Deviation; "Min", minimum reported value and "Max", maximum reported value.

Source: own elaboration based on primary data

With respect to fuel costs, interviewees were encouraged to report both monetary expenditures and number of gallons used in an average trip. In some cases, the responses where coherent and expenditures matched the number of gallons when valuing the latter at current prices. In some others, monetary expenditures were above the reported number of gallons. To solve this issue, I relied on the number of gallons as a more accurate indicator of gas usage in a typical trip, and multiplied it by the average gas price of 2016 (XCD 11.2/gallon). Based on this, the mean and median fuel expenditures per trip amounted to XCD 147 and XCD 112. The difference is explained by the maximum value of XCD 675, that constitutes a clear outlier.

Interviewees found it difficult to report on ice-related expenditures. The main reason was that 14 out of the 18 boat owners indicated that they make their own ice. In those cases, follow-up questions were asked about the extra monthly electricity expenditures related to ice-making. Those figures were divided by the reported average number of trips made in a typical month, to obtain an estimate of per-trip ice costs.

Opposite to ice costs, reported bait costs were relatively consistent among fishing boats. The most common practice is for fishermen to purchase the bait; only 4 of the interviewees reported to catch it sometimes. Squid is the prevailing bait used. Fishermen claimed to use between one and three boxes of squid every trip, purchased at a price of XCD 52. Very often, squid is complemented with ballyhoo, purchased at an average price of XCD 17.6 per kg (XCD 8 per lb.).

Following Pascoe et al. (2015), vessels maintenance and gear replacement costs can be considered as having both fixed and variable components. Thus, these can be regarded as **mixed costs**. In other words, maintenance is needed every year regardless the amount of catch, for example due to exposure to salt water or heat. Nevertheless, the more a fishing vessel is used, the more the need for repairs and maintenance. A similar reasoning can be applied to gear replacement.

Only nine interviewees could report estimates on annual boat maintenance costs, which are primarily related to haul-up and painting. The median expenditure, reported in Table 3, amounts to XCD 2200. With respect to engine maintenance and servicing, the mean annual expenditure is XCD 1,480, ranging from XCD 200 to XCD 7,200, with a median value of XCD 850. The large difference between the mean and the median is explained by the maximum value of XCD 7,200. Excluding it from the sample yields a mean value of XCD 844, similar to the median value.

Table 3. Boat structure and engine maintenance costs of Montserratian commercial fishing fleet (XCD)

Variables	N	Mean	Median	Std. Dev.	Min	Max
Boat structure	9.0	1,880	2,200	1,093	500	3,500
Engine (per unit)	10.0	1,480	850	2,060	200	7,200

Note: "N" denotes number of responses; "Std. Dev.", Standard Deviation; "Min", minimum reported value and "Max", maximum reported value.

Source: own elaboration based on primary data

To estimate annual gear replacement costs, data on unit costs, estimated lifetime, and actual number of units per boat for every type of gear were collected. Table 4 presents descriptive statistics for these variables.

Table 4. Number per vessel, lifetime (years) and unit costs (XCD) of fishing gears used by Montserratian commercial fishing fleet

Gear	Assoc. Fisheries	Variables	N	Mean	Median	Std. Dev.	Min	Max
Handline	Reef & Ocean Pelagic	*Number per vessel*	13	2,5	2,0	0,9	2	4
		Lifetime	3	11,8	12,5	8,5	3	20
		Unit cost	12	295	288	98	180	500
Fishing pot	Reef	*Number per vessel*	12	25,1	21,0	18,6	5	70
		Lifetime	12	0,8	0,8	0,2	1	1
		Unit cost	12	286	238	154	110	600
Seine Net	Coastal Pelagic	*Number per vessel*	2	1,5	1,5	0,7	1	2
		Lifetime	1	6,5	6,5	-	-	-
		Unit cost	1	5.000	5.000	-	-	-
Bottom longline	Reef & Ocean Pelagic	*Number per vessel*	6	3,2	2,5	2,6	1	8
		Lifetime	4	1,5	1,1	1,4	1	4
		Unit cost	5	323	250	279	80	800
Rod & Reel	Reef & Ocean Pelagic	*Number per vessel*	5	4,8	4,0	4,2	1	12
		Lifetime	2	4,3	4,3	1,1	4	5
		Unit cost	3	1.135	986	430	800	1.620
Gill net	Coastal Pelagic	*Number per vessel*	6	1,7	2,0	0,5	1	2
		Lifetime	5	3,4	2,0	3,0	1	8
		Unit cost	6	1.116	837	761	500	2.480
Speargun	Reef, Coastal and Ocean Pelagic	*Number per vessel*	4	2,5	2,0	1,9	1	5
		Lifetime	0	-	-	-	-	-
		Unit cost	3	497	450	427	95	945

Note: "N" denotes number of responses; "Std. Dev.", Standard Deviation; "Min", minimum reported value and "Max", maximum reported value.

Source: own elaboration based on primary data

5.2.2 Valuation strategy: estimating value added

Following the definitions presented in chapter 2, the total GVA and NVA of commercial fishing in 2016 were estimated as follows:

$$Gross\ Value\ Added = Gross\ revenue - variable\ costs - \ mixed\ costs \quad (1)$$

$$Net\ Value\ Added = Gross\ Value\ Added - depreciation\ costs \quad (2)$$

To calculate **gross revenue**, the total catch by type of fishery (reef, CP, and OP) was multiplied by the corresponding market prices.

Reported costs of *sampled and monitored* vessels and engines were used to estimate annual **depreciation costs**. To calculate the annual rate of depreciation for fishing vessels and engines, questions related to the estimated lifetime of boat and engines were included in the interviews. However, only a handful of the respondents could provide estimates. Therefore, I decided to follow Oxenford et al. (2010) and based our analysis on an annual rate of depreciation of 4% for fishing vessels and 10% for engines. I approximated the investment costs of the *non-sampled* boats by using the median values reported in Table 1, assuming that these had one engine.

As for the annual **variable costs**, in the cases of fuel and bait I multiplied each *sampled and monitored* vessel´s reported per-trip expenditures by the number of trips made in 2016. Note that for the *non-sampled* boats, I used the median expenditures in Table 2. In the case of ice, given the lack of reliable responses at the individual level, I used the median value in Table 2 for both the *sampled and monitored* and the *non-sampled* boats, and then multiplied it by each vessel´s number of trips.

The annual **mixed costs** are the result of aggregating annual maintenance costs and gear replacement costs. To estimate annual maintenance costs, I followed a similar reasoning as with ice and used the median values of Table 3. Thus, for the *sampled and monitored* boats with one reported engine I assumed a total annual maintenance cost of XCD 3050, and for the boats with two reported engines, XCD 3900.

To estimate annual replacement costs, I based on the following formula:

$$Annual\ gear\ replacement\ cost_{i,t} = \left(\frac{reported\ unit\ cost_{i,t}}{average\ unit\ lifetime_t}\right) * N^{\underline{o}}\ of\ units\ owned_{i,t} \tag{3}$$

where i denotes the vessel and t the type of gear. This formula was applied for every type of gear and every vessel. The results were first aggregated for each vessel and then across them to arrive at the total annual gear replacement cost for the total fleet. To overcome the lack of data about gear used by the *non-sampled* boats, I proceeded as follows. The official database includes general information about the main gear used in each recorded trip. This does not include the number of units, and does not account for other types of gears that could have also been used or owned. I used this information and assumed that each of the *non-sampled* boats had only the main type of gear reported in the database. I then approximated their annual replacement cost using the average (corresponding to that specific gear) of the estimates for the *sampled and monitored* boats.

Finally, to gain a better insight into the value created from each main group of fish species, revenue and costs by type of fishery (reef, CP, and OP) were disaggregated. While I counted with gross revenue for each type of fishery, data on costs were only at the aggregate level. Given that commercial boats can eventually target and catch species from different groups during their trips, it was necessary to attribute costs using an allocation key.

Following Hundloe (2002), when separate records on the fishing costs that are attributable to each fishery are not available, a second-best option would be to allocate costs according to the time spent in each fishery. In the absence of such information, as it is the case in this study, another option is to assign costs in proportion to the amount of catch or gross revenue corresponding to each fishery. Given data availability, I decided to follow the latter alternative and consider the amount of catch per species as a proxy to determine the fishing efforts devoted to each type of fishery. It is acknowledged, however, that this is only reflects an approximation of the true allocation. Other variables that are currently unknown, such as relative abundance of species or gear characteristics potentially affect the allocation of costs. Detailed information on the share of catch for each vessel and type of fishery is provided in Appendix E.

6. Results

In this chapter, the main results are presented and interpreted. Section 6.1 discusses the (gross and net) value added generated by commercial harvesting activities. Section 6.2 estimates how much additional value is created when intermediate transactions occur before fish reaches the final consumer.

6.1 Value added of commercial fisheries

Based on the official records, in 2016 the total revenue from all species landed by the commercial fleet of Montserrat was XCD 548,280, which represented 0.3% of GDP. Reef fish landings accounted for around 56% of total revenue in 2016, followed by CP landings (40%) and OP (4%). It is important to remark that 70% of the difference in the gross revenue between reef and CP catch is explained by the higher price of the former type of species.

Fishing costs added up to XCD 373,374. The largest expenditures were related to mixed costs. These amounted to XCD 188,847, mainly explained by gear replacements. Variable costs were XCD 129,957, primarily due to fuel and bait. Finally, depreciation costs reached XCD 54,570. By subtracting total variable and mixed costs from total revenue, I arrived at an estimated GVA of XCD 229,476 (USD 84,991). Accounting also for depreciation costs, the NVA was XCD 174,906 (USD 64,780). Recalling that no wages are paid and that the activity is not taxed, the NVA can also be regarded as the producer surplus of the harvesting activities. Considering that 27,373 kg (60,348 lbs.) of fish were caught in 2016, this implies that GVA and NVA per kg (lb.) of fish were on average XCD 8.4 (XCD 3.8) and XCD 6.4 (XCD 2.9), respectively. The results are presented in Table 5.

The disaggregation of revenue and costs by type of fishery enables to make some further remarks. While the highest gross revenue was derived from reef catch, CP species yielded the highest net value added, both in absolute and relative terms. Note that in relative terms, the NVA of CP was 65% of its gross revenue, followed by OP (21%) and reef (9%).

There are several reasons behind the large differences in NVA of CP and reef fisheries. Firstly, there were only two boats targeting primarily CP species, with 98% of its total catch explained by the activities of these two boats (around 12,247 kg) that made in total 158 trips. On the contrary, reef fishing efforts were wider, and nine boats making in total 297 trips were needed to catch an equivalent amount of reef fish. The higher number of trips for a similar amount of catch explained the larger variable costs of reef fishing.

Table 5. Gross Value Added (GVA) and Net Value Added (NVA) of commercial fishing in 2016 (XCD)

Net value added (NVA) of commercial fishing in 2016 (XCD)				
	Reef	Coastal Pelagic	Ocean Pelagic	Total
(+) Gross Revenue	**306.506**	**220.785**	**20.989**	**548.280**
(-) Fixed Capital costs	**41.124**	**10.080**	**3.366**	**54.570**
Depreciation	41.124	10.080	3.366	54.570
(-) Variable costs	**77.373**	**46.383**	**6.158**	**129.914**
Fuel	45.376	22.361	3.546	71.283
Ice	5.105	2.555	473	8.134
Bait	26.892	21.466	2.139	50.498
(-) Mixed costs	**160.411**	**21.294**	**7.142**	**188.847**
Gear replacement	109.262	10.836	3.498	123.597
Vessel & engine maintenance	51.149	10.457	3.644	65.250
NVA	**27.598**	**143.028**	**4.322**	**174.949**
NVA (% Gross Revenues)	**9%**	**65%**	**21%**	**32%**

Differences in depreciation and maintenance costs are due to two main reasons. Firstly, except for the two referred boats targeting CP species, all the remaining boats were mainly catching reef fish. Recalling that I allocated costs according to the share of catch from each fishery, this explains the differences in fixed and mixed costs between the referred fisheries. An additional reason is that reef fishing is mainly done with fishing pots, while CP fishing is done with seine and gill nets. The total fishing pots replacement cost in 2016 was XCD 108,927. Conversely, the total seine and gill nets replacement cost was found to be XCD 4,334. As suggested in Table 4, a relatively high unit cost does not only explain the high figure for fishing pots replacement, but also their relatively shorter lifetime and the higher number of units per boat.

6.2 Increased value with downstream operations

Fishermen of Montserrat do not only sell their catch directly to private households (i.e. final consumers), but also to restaurants. Thus, the catch can follow an alternative route in the supply chain in which intermediate market transactions before the catch is finally consumed. As the catch follows this alternative pathway value is created in each step of the supply chain, which contributes to the local economy. As discussed in chapter 2, this additional value should also be accounted for.

An attempt was made to estimate how much of the total catch takes this alternative pathway. However, neither restaurants nor fishermen could provide reliable estimates. Note that by having an estimate on the total catch that is purchased by restaurants every year, I could approximate the total additional value created by their activities. As a second-best option, I estimated how much the value of a lb. of fish increases as this moves through the referred pathway.

A very common practice is for restaurants to buy the fish directly from fishermen at the market prices (mainly reef and OP species), and have it cleaned by fish cleaners for XCD 4.4 per kg (XCD 2 per lb.). The price of sale of a typical fish meal is relatively consistent among restaurants, and averages

XCD 25. Restaurant owners indicated they can make around two meals out of an average lb. of fish (before cleaning).

Under the common practice, fish cleaning is labor intensive and the only cost is the depreciation of their tools (scale removers, knives and shears), of which no estimates are available. Thus, it can be argued that the GVA of this activity is XCD 4.4 per kg (XCD 2 per lb.) of fish. However, it would be misleading to follow the same reasoning for restaurants. These do incur several intermediate costs (e.g. utilities, supplies) that should also be accounted for. Information on the average costs and net revenue was obtained from ten Montserratian restaurants. This data was used to approximate the average costs and net revenue of a typical fish meal, presented in Table 6.

Table 6. Average costs and net revenue of a fish meal for a typical Montserratian restaurant (% of gross revenue)

Components	% of Gross revenue
Costs	***95%***
Food supplies	*40%*
Wages	*25%*
Occupancy	*25%*
Other costs	*5%*
Net revenue	***5%***

Based on the above figures, an average fish meal that is sold for XCD 25 has a cost of XCD 10 (40%) in ingredients or *food supplies*[7]; XCD 6.25 (25%) in *wages*; XCD 6.25 (25%) in *occupancy* costs and XCD 1.25 (5%) in *other costs*. *Net revenue* per meal is XCD 1.25 (5%). *Wages* and *net revenue* are the only components that should be considered as part of GVA. Bearing this in mind, the average GVA of a typical fish meal amounts to XCD 7.5. Note that the lack of data on depreciation costs for restaurant equipment prevented us from estimating NVA.

Summing up, an original kg (lb.) of fish increases its value in XCD 4.4 (XCD 2) at the cleaning stage and in XCD 33.1 (XCD 15) at the restaurants stage, recalling that restaurants make two meals out of one lb. of non-cleaned fish. This result has a very relevant implication. When a kilogram (pound) of fish follows a pathway that includes cleaners and restaurants as intermediate actors before reaching the final consumer, an additional gross value of XCD 37.5 (XCD 17) is created, multiplying the GVA of the harvesting stage by almost 4.5 times. Figure 6 summarizes the outlined pathways and their corresponding GVA.

[7] Note that the costs of ingredients of a fish meal go beyond those of the fish itself, and include side items (e.g. rice, fries) and condiments, although fish constitutes the dominant cost. Considering this and the fact that restaurants incur into a fish cost of XCD 6 per meal, our estimate of ingredients costs seems to be consistent.

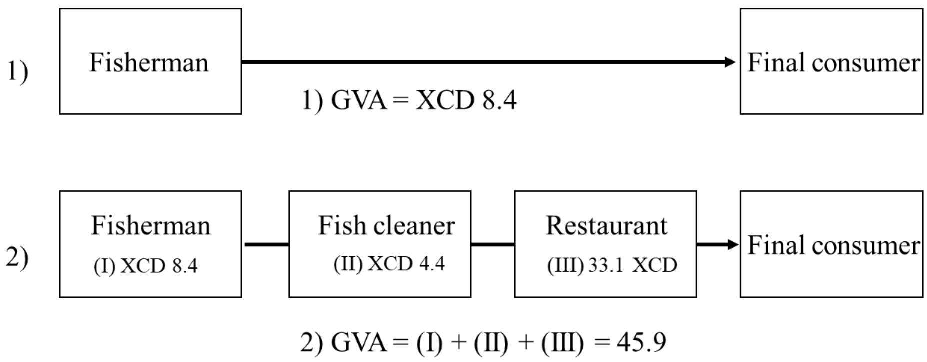


Figure 6. GVA per kilogram of fish: two typical pathways

7. Discussion and policy implications

The results presented in the previous chapter can be coupled with complementary (formally and informally) collected data to derive and bring into perspective several policy implications for the local fishing sector.

Within the limitations of the present research, I have estimated the GVA 2016 of the Montserratian commercial fishing sector at XCD 229,476 (USD 84,991), around 0.2% of GDP. I have also estimated the NVA of the activity at XCD 174,906 (USD 64,780), approximately 0.1% of GDP. In absolute terms, these figures lie below the estimates presented by similar studies carried for other countries of the WCR (see chapter 3). As a share of GDP, however, the monetary contribution of the activity is in line with the results found in the region. Comparisons should be handled with care. The case studies reviewed in this document do not exactly coincide in the approaches to valuation, types of values, study areas and time frames considered. These issues affect findings and thus complicate comparability. It is also important to highlight that our results constitute an underestimate of the real situation, since as explained in section 5.1, severe underreporting of trips and catch is certainly occurring (results indicate that 50% of the fishing trips are recorded).

The NVA estimate can be interpreted as an approximation to the total net profit of the commercial fishing activities during the referred year. It can also be considered as a partial measure of the total value attributable to the ecosystem services generated by local fish stocks. As acknowledged in chapter 2, the valuation is only partial in the sense that neither non-market and non-use values are taken into account, nor consumer surplus considerations are made.

Estimates of value-added by type of fisheries have several implications. To begin with, it is remarkable that the main targeted fishery (reef) is, in relative terms, the least profitable. From a purely economic perspective, the results suggest that the overall value of the harvesting activities could be enhanced if at least part of the fishing efforts devoted to reef species were transferred to coastal and/or ocean pelagic species. These comments should be taken with care. First, reef species catch and consumption is culturally valued by many fishermen (especially the older ones) and local consumers. Any strategy aiming to reduce the reef catch should not disregard the effect this could have in the customs and traditions of at least part of the population. Second, comprehensive research is needed to investigate what the sustainable harvesting levels are for reef and pelagic species to understand the actual margin in which these resources can be sustainably exploited.

Only if the actual harvesting levels of coastal and ocean pelagic species were below the sustainable levels and thus, there was a margin to pursue this substitution, several benefits could be acquired. Firstly, substituting reef catch would not only be positive from a costs and revenue perspective. It would also relieve coral reefs from the actual fishing pressures, one of the objectives outlined in the *National Fisheries Report 2016* (Ponteen, 2016). Reducing the efforts devoted to harvesting reef species could also come with an increase in the overall value of coral reefs as a source of several other ecosystem services.

Conversations held with the many actors involved in the Montserratian fisheries suggest that there is a great economic potential in further exploiting ocean pelagic species. Note that given the morphology of the island, these types of species can be encountered relatively close to the shore. This already supposes an advantage from a variable costs perspective. In addition, although fishermen acknowledged that an upgrading in equipment and perhaps vessels and engines would be needed to increase the ocean pelagic catch, there are reasons to believe that *economies of scale* would play their part. In other words, with the initial required fixed costs spread out over an increasing level of catch, a lower average cost per unit of output would be achieved. This would increase the net revenue of fishermen and place them into a virtuous cycle of higher investment, higher fishing efforts and higher catch. Not only new direct employments could be created, but a reinforcement of the downstream effects would be achieved.

Ocean pelagic species are especially appreciated by local restaurants, who can fillet and handle them with relative ease. Approximately 40% of the fish served by local restaurants is (cleaned and filleted) imported fish. Restaurants buy this imported fish, on average, at a price that is 20% higher than that of local and cleaned ocean pelagic fish. There are two main reasons why restaurants buy imported fish: the unpredictability of local supply and the undersupply of ocean pelagic species, the substitute par excellence of imported fish. All the interviewed restaurants owners claimed they would be willing to substitute imported fish by local ocean pelagic species if they could have more access to it. Thus, increasing local catch would reduce the dependence of restaurants on imported fish. With this, an increased share of the already substantial value that restaurants create would be sourced in local and higher quality fish.

The Montserratian Government has a key role to play in triggering the above described dynamics. The absence of essential infrastructure constitutes a barrier for the development of the sector. Among the main concerns of local fishermen (See Annex F) is the need of a fishing harbour: their incentives to invest are hindered by the lack of an appropriate landing site. Easier and cheaper access to equipment is another major need. The authorities could contribute to eliminate the shipping/travelling costs in which fishermen incur when they need equipment, by for example making it available locally at a price that is at least closer to the one of origin. The possibilities of selling fishermen gas at the wholesale price (instead of retailer price, like in the current situation) should also be considered. These actions, among several others, would all contribute to diminish the fishing costs, increase the value added of the activity and foster the virtuous circle explained before.

To make this process inclusive, heterogeneities among fishermen should not be disregarded. Special attention should be put on those who lack the financial resources to accompany these dynamics. In informal conversations, several fishermen recognized their impossibility to have access to credit and to financial services in general. This constitutes a clear barrier to investment initiatives. The implementation of micro-finance schemes appears as a tool with large potential to fill in this gap, and could be explored.

Sale prices of local fish should also be discussed and perhaps revised. To the best of my knowledge, prices of local fish have remained stable during the last years, without even adjusting by inflation. This constitutes a clear disadvantage for fishermen, whose source of income lags yearly with respect to the rest of the prices in the economy, reducing their purchasing power. In addition, while a thorough analysis would be needed to understand what the equilibrium price of fish should be, it is evident that the demand of local fish (better appreciated than imported fish) is not being fully satisfied. Thus, an increase of the former that could at least match the sale price of the latter should be considered. This would enable to increase the profit margin of fishermen as well as the value added and investment in the activity.

Finally, it is critically important that the official data collection system is upgraded and professionalized. Without timely, accurate and comprehensive information, the sector will remain caught in a vicious circle of informality, overlooking, and lack of appropriate governmental attention and support. This not only undermines the possibilities of the fishing community to progress. It also neglects its potential as a source of dynamism and positive spillover effects on downstream activities and the local economy as a whole.

8. Limitations and future research

The results presented in this document are conditioned by the quality of the available data. In this sense, there are several deficiencies that should not be disregarded.

On the one hand, it has already been mentioned that the official database on fish landings presents severe flaws, related to underreporting of both fishing trips and catch. Thus, not only gross revenue is affected downwards, but also those costs that do not vary with the number of trips or amount of catch (e.g. fixed capital costs) are relatively overestimated. Overall, this has a direct consequence on the results of GVA and NVA presented in section 6.1, deriving in an underestimate of the true values.

On the other hand, the reliability of the analysis is closely linked to the quality of the information provided by boat owners and captains. In this sense, none of the interviewees replied to our questions on fishing costs appealing to written records, but to their memory. In particular, responses on variable costs (fuel, ice, bait) were based on average expenditures. However, these may vary largely depending on the characteristics of each trip, including the amount of catch, weather conditions, distance traveled, and time spent fishing. The lack of such detailed information limited our costs analysis. In addition, note that fishermen incur extra shipping/transport costs to purchase their equipment. However, these were not accounted for in our analysis, because fishermen found difficulties in estimating the frequency with which these costs were incurred and their amounts. This also may affect the quality of our results by underestimating the total fishing costs, since not all of them were considered.

Another point of concern is related to the representativeness of the *sampled* boats in 2017 with respect to the (eight) *non-sampled* but monitored boats in 2016. The data gap corresponding to these missing boats was filled using median responses of the (18) *sampled* boats. Although Mr. Ponteen suggested that these missing boats do not affect the overall representativeness of the interviewed sample, I must acknowledge this as a clear limitation to our analysis.

As recognized in chapter 7, the conclusions derived from our economic analysis must be taken with care, and should be complemented with further research to understand what are the sustainable harvesting levels for coastal and ocean pelagic species and what is the actual margin to exploit those resources further. It would also be necessary to investigate whether locals would be willing to accept a potential reduction of the reef catch, considering the cultural value many of them probably place on these species.

Overall, our estimates constituted a first step towards a broad understanding of the welfare created by the fishing industry on Montserrat. Note that a total valuation should also have considered consumer surplus as well as non-market and non-use values derived from Montserrat´s fisheries, including for example the value of fish for local nutrition or the cultural and recreational value of fishing activities. While this was beyond the scope of our study, it constitutes an interesting line for future research.

The results on increased value with downstream transactions (section 6.2) should only be considered as an approximation. To carry these calculations, I used data on average costs and net revenue of ten restaurants. Considering that this is private information which restaurants are usually reluctant to reveal publicly, the quality of their responses also conditions the accuracy of our results. In addition, I could not estimate the amount of catch that is purchased by restaurants and fish vendors. Furthermore, I did not have access to the actual number of establishments of these kinds on the island. This prevented us from estimating the total additional amount of value that is created when fish goes through intermediate transactions before reaching the final consumer. Although the estimate per pound may be a good approximation, future research should point towards a more comprehensive calculation, so that both the total value added of the harvesting activities and of its related downstream operations could be accounted for.

List of references

Agardy, M.T., Dayton, P.K., Hofman, R.J. and Thrush, S.F. (1995). Environmental effects of marine fishing. *Aquatic Conservation, Marine and Freshwater Ecosystems, 5(3)*, 205-232.

Agarwal, B.L. (2006). *Basic Statistics*, 4th edition, New Delhi: New Age International Publishers.

Allison, E.H., Andrew, N.L., Béné, C., Hall, S.J., Heck, S. and Ratner, B.D. (2007). Diagnosis and management of small-scale fisheries in developing countries. *Fish and Fisheries 8(3)*, 227–240.

Barbier, E.B., Hacker, S.D., Kennedy, C., Koch, E.W., Stier, A.C. and Silliman, B.R. (2011). The value of estuarine and coastal ecosystem services. *The Ecological Society of America*, *Ecological Monographs 81(2)*, 69-193.

Barnes-Mauthe, M., Oleson, K.L.L. and Zafindrasilivonona, B. (2013). The total economic value of small-scale fisheries with a characterization of post-landing trends: an application in Madagascar with global relevance. *Fisheries Research 147*,175-185.

Batista, V. S., Fabré, N.N., Malhado, A.C.M. and Ladle, R.J. (2014). Tropical Artisanal Coastal Fisheries: Challenges and Future Directions. *Reviews in Fisheries Science & Aquaculture, 22(1)*, 1–15.

Bockstael, N. E., Freeman, A.M., Kopp, R.J., Portney, P.R. and Smith, V.K. (2000). On measuring economic values for nature. *Environmental Science and Technology 34(8)*, 1384-1389.

Booth, S., Pauly, D. and Zeller, D. (2006). *Fisheries Contribution to GDP: Underestimating Small-scale fisheries in the Pacific*. Marine Resource Economics, Fisheries Centre, University of British Columbia.

Burke, L., Cooper, E., Greenhalgh, S. and Prager, D. (2008). *Economic valuation of coral reefs in Tobago and St. Lucia*. Final report, World Resources Institute, Washington DC, pp. 66.

Burke, L., Bood, N. and Cooper, E. (2009). *The Economic Contribution of Belize's Coral Reefs and Mangrove*s. Working Paper, World Resources Institute, Washington DC, pp. 53.

Burke, L., Cooper, E., Waite, R. and Zenny, N. (2011). *Coastal Capital: Jamaica. The Economic Value of Jamaica's Coral Reef-Related Fisheries*. Working Paper, World Resources Institute and The Nature Conservancy, Washington, DC.

Charles, A., Chuenpagdee, R., Salas, S. and Seijo, J.C. (2007). Challenges in the assessment and management of small-scale fisheries in Latin America and the Caribbean, *Fisheries Research, 87(1)*, 5–16.

Costanza, R., d´Arge R., de Groot, R., Farber, S., Grasso, M., Hannon, B., Limburg, K., Naeem, S., O´Neill, R.V., Paruelo, J., Raskin, R.G., Sutton, P. and van den Belt, M. (1997). The value of the World´s Ecosystem Services and Natural Capital. *Nature, 387*, 253-260.

Costanza, R. (1999). The ecological, economic, and social importance of the oceans. *Ecological Economics, 31(2)*, 199–213.

Daily, G.C., Alexander, S., Ehrlich, P.R., Goulder, L., Lubchenco, J., Matson, P.A., Mooney, H.A., Postel, S., Schneider, S.H., Tilman, D. and Woodwell, G.M. (1997). Ecosystem services: benefits supplied to human societies by natural ecosystems. *Issues in Ecology, 2*, 1–16.

de Boer, B., Jansen, H., Hueting, Lambooy, J. and R., Reijnders, L. (1998). The concept of environmental function and its valuation. *Ecological Economics, 25(1)*, 31-35.

EC (2010). *European system of accounts*. Eurostat, European Commission, ISBN 978-92-79-31242-7.

FAO (2002). *CWP Handbook of Fishery Statistical Standards*. Section K: FISHERS. CWP Data Collection. In: Food and Agriculture Organization of the United Nations, Fisheries and Aquaculture Department [online], Rome.

FAO (2004). *A research agenda for small-scale fisheries*. Food and Agriculture Organization of the United Nations, FAO Regional Office for Asia and the Pacific, Bangkok, Thailand. RAP PUBLICATION No. 2004/21 and FIPL/C 10009 (En), pp. 42.

FAO (2005). *Increasing the contribution of small-scale fisheries to poverty alleviation and food security.* Food and Agriculture Organization of the United Nations, Technical Guidelines for Responsible Fisheries 10, Rome, pp. 79.

FAO (2011). *Coastal fisheries of Latin America and the Caribbean*. Food and Agriculture Organization of the United Nations, Fisheries and Aquaculture Technical Paper Nº544, Rome, pp. 444.

FAO (2012). *Recreational fisheries*. Food and Agriculture Organization of the United Nations, Technical Guidelines for Responsible Fisheries. No. 13. Rome, pp. 176.

FAO (2014). *The state of world fisheries and aquaculture.* Opportunities and Challenges. Food and Agriculture Organization of the United Nations, Rome, pp. 243.

FAO (2016a). *The state of world fisheries and aquaculture. Contributing to food security and nutrition for all.* Food and Agriculture Organization of the United Nations, Rome, pp 200.

FAO (2016b). *The value of billfish resources to both commercial and recreational sectors in the Caribbean.* By Brad Genter, Food and Agriculture Organization of the United Nations, Fisheries and Aquaculture Circular Nº1125, Bridgetown, Barbados.

FAO (2016c). *Technical and socio-economic characteristics of small-scale coastal fishing communities, and opportunities for poverty alleviation and empowerment*. Food and Agriculture Organization of the United Nations, Fisheries and Aquaculture Circular Nº 1111, Rome, pp. 136.

Farber, S., Costanza, R., Childers, D.L., Erickson, J., Gross, K., Grove, J.M., Hopkinson, C., Kahn, J., Pincetl, S., Troy, A., Warren, P. and Wilson, M. (2006). Linking Ecology and Economics for Ecosystem Management. *Bioscience, 56(2)*, 121-133.

Folke, C. and Moberg, F. (1999). Ecological goods and services of coral reef ecosystems. *Ecological Economics, 29(2)*, 215-233.

Fourqurean, J.W., Kenworthy, W.J., Powell, G.V.N. and Zieman, J.C. (1991). Bird colonies cause seagrass enrichment in a subtropical estuary: observational and experimental evidence, *Estuarine, Coastal and Shelf Science, 32*, 567–579.

Freeman, A. M. (1993). *The measurement of environmental values and resources: theory and methods*, Resources for the Future, Washington DC.

GOM (2013). *Fisheries Act and Subsidiary Legislation*. Revised edition showing the law as at 1st of January 2013, prepared by the Law Revision Commissioner, Government of Montserrat, Montserrat.

Gustavson, K. (1998). *Values Associated with the Local Use of the Montego Bay Marine Park*. World Bank Research Committee Project #RPO 681-05, pp. 41.

Hammer, M. and Holmlund, C.M. (1999). Ecosystem services generated by fish populations. *Ecological Economics, 29*, 253-268.

Hughes, T.P. (1994). Catastrophes, phase shifts, and large-scale degradation of a Caribbean coral reef. *Science, 265*, 1547–1551.

Hundloe, T. (2002). *Valuing Fisheries: An economic framework*. Australia, McPherson´s Printing Group.

Johnson J., Mahon, R., Parker, C., Snickler, T., Willoughby, S. (2007). *The Value of Barbados´ Fisheries: A Preliminary Assessment*, CERMES, UWI Cave Hill, Barbados, 89-94.

Lee, R. (2017). *Montserrat. Marine and Fisheries Sectors Report*, Overseas Countries and Territories Innovation Project.

Marshood, R., Richardson Temm, G. and Stedman-Edwards, P. (2008). *The global fisheries crisis, poverty and coastal small-scale fishers. Lessons from six case studies*. Joint publication between WWF MPO Poverty Environment Program and the WWF US Fisheries Program.

MEA (2005). *Ecosystems and human wellbeing: synthesis*. Millennium Ecosystem Assessment, Island Press, Washington DC.

Moyle, P.B. and Moyle, P.R. (1995). Endangered fishes and economics: intergenerational obligations, *Environmental Biology of Fishes, 43(1)*, 29–37.

NAS (2008). *Marine ecosystems and fisheries*. Highlights of National Academies Reports, Ocean Science Series, National Academy of Sciences.

NOAA (2006). *NOAA fisheries glossary*. National Oceanic and Atmospheric Administration, Technical Memorandum NMFS-F/SPO-69, United States Department of Commerce.

Norse, E. A. (2010). Ecosystem-based spatial planning and management of marine fisheries: why and how? *Bulletin of Marine Science, 86 (2)*, 179-195.

Oxenford, H.A., Schuhmann, P.W., Staskiewicz, T. and Walcott, J. (2010). *Landings, costs, net profit and return on investment in two contrasting fisheries, Part 1: The longline fishery*. Second project report on the economic valuation of fisheries in Barbados, Fisheries Division, Ministry of Agriculture, Barbados, pp. 59.

Pascoe, S., Thebaud, O. and Vieira, S. (2015). Allocating repairs and maintenance costs to fixed or variable costs in fisheries bioeconomic models. *Applied Economics Letters, 22(2)*, 127-131.

Ponteen, A. R. (2013). *The future of fisheries in Montserrat: a proposed framework for management and governance reform*. Dissertation submitted in partial fulfillment of the requirements for the degree of MSc Coastal and Marine Resource Management, University of Portsmouth, Department of Geography.

Ponteen, A. R. (2016). *Montserrat National Fisheries Report 2016*. Fisheries Division, Government of Montserrat, Montserrat.

Schuhmann, P.W. (2012). T*he valuation of marine ecosystem goods and services in the Caribbean Region*, CERMES Technical Report, Nº 63.

UCSB (2015). *A Review of the Ecology and Economics of Montserrat's Marine Resources*. University of California, Santa Barbara, United States.

UNEP (2006). *Marine and coastal ecosystems and human wellbeing: A synthesis report based on the findings of the Millennium Ecosystem Assessment*. United Nations Environment Programme, pp. 76.

van Beukering, P., Brander, L.M., Cesar, H.S.J. (2006). The Recreational value of Coral Reefs: A Meta-Analysis. *Ecological Economics 63(1)*, 209-218.

van Beukering, P., Brander, L., Tompkins, E. and McKenzie, E. (2007). *Valuing the Environment in Small Islands – An Environmental Economics Toolkit*. ISBN 978 1 86107 5949.

van Beukering, P., Sarkis, S., McKenzie, E., Hess, S., Brander, L., Roelfsema, M., Looijenstijn-van der Putten, L., Bervoets, T. (2010). *Total economic value of Bermuda's coral reefs; valuation of ecosystem services*. Report for the Department of Conservation Services of the Government of Bermuda.

van Beukering, P., Brander, L., van Zanten, B., Verbrugge, E. and Lems, K. (2011). *The economic value of the coral reef ecosystems of the United States Virgin Islands*. IVM Report number (R-11/06), Institute for Environmental Studies, VU University Amsterdam, Amsterdam, The Netherlands, pp. 177.

van Beukering, P., Johnson, A., Schep, S. and Wolfs, E. (2012). *The Fishery Value of Coral Reefs in Bonaire*. Institute for Environmental Studies, Vrije Universiteit Amsterdam, Amsterdam, The Netherlands.

van Beukering, P., Brower, R. and Koetse, M.J. (2015). *Economic values of ecosystem services* and *Economic valuation of ecosystem services*. In: Bouma, J. and van Beukering P.J.H. (Eds.), Ecosystem services: from concept to practice. Cambridge University Press (Chapters 5 & 6).

Consulted websites

Eastern Caribbean Central Bank statistics (ECCB) - http://www.eccb-centralbank.org/Statistics/

Appendix

A. Interview schedule: commercial fishermen

Federico Fraga, on behalf of Vrije Universiteit Amsterdam, Wolfs Company and JNCC

INTRODUCTION: I am interviewing fishermen on Montserrat to learn your opinions, the methods of fishing, the types of fish that you catch and your costs and revenue. Any information from these interviews that is published or shared will be aggregated results of all interviewed fishermen, and will not include your name (it will be anonymous). Would you be willing to help me with my project by letting me interview you?

Section A: General information

1) Gender
- ☐ Male
- ☐ Female

2) Age: _____

3) Number of people in your household (including yourself): __________

4) Fishing experience in years: __________

5) What is your reason to go fishing? If more than one reason, please rank using 1 and 2 (if two reasons) or 1,2 and 3 (if all three reasons; 1 being most important reason)
- ☐ I fish for my own consumption
- ☐ I fish to generate financial income
- ☐ I fish for recreational/enjoyment purposes

6) What would you say is your main occupation? __________

i. ☐ Full-time ☐ Part-time
ii. ☐ All year around ☐ Seasonal

Additional occupation(s):

a) __________
i. ☐ Full-time ☐ Part-time
ii. ☐ All year around ☐ Seasonal

b) __________
i. ☐ Full-time ☐ Part-time
ii. ☐ All year around ☐ Seasonal

EXTRA NOTES FOR SECTION A:

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Section B: Fishing equipment specification

I. Fishing boat

1) How many fishing boats do you use? #__________

IF DIFFERENT FROM “0”:

i. How many people do you usually fish with? #__________

ii. What is your landing site? If more than one site, please rank using 1 and 2 (if two sites), 1,2 and 3 (if three sites) and so on, being 1 the most often landing site

- ☐ Little Bay
- ☐ Bunkum Bay
- ☐ Isle´s Bay
- ☐ Woodland´s beach
- ☐ Other (specify): __________

2) How many fishing boats do you own? #__________

IF DIFFERENT FROM “0”:

i. What is the source of the fishing boat you own?

	Self-fabricated	Purchased	Other (specify)
Boat 1			
Boat 2			

ii. How many people (including yourself) own the boat?

Boat 1: __________
Boat 2: __________

Only proceed if at least one of the answers to 1) and 2) is different from “0”. Otherwise, continue in Section B. II

3) Boat(s) characteristics

	Length (in feet)	Motorized		Inboard (I) or Outboard (O)?		Petrol (P) or Diesel (D)?		Horsepower
Boat 1		☐ Yes	☐ No	☐ I	☐ O	☐ P	☐ D	
Boat 2		☐ Yes	☐ No	☐ I	☐ O	☐ P	☐ D	

Questions 4-12 in this section only apply to **boat owners:**

4) In case you do not go fishing yourself, how many people use your boat to fish?
Boat 1: __________
Boat 2: __________

5) For how long have you had your boat? (unit time as easiest to specify)
Boat 1: __________
Boat 2: __________

6) From this moment on, for how long do you think you will be able to use your boat(s) until you must replace it? (unit time as easiest to specify)
Boat 1: __________
Boat 2: __________

7) How much did your boat cost? (total purchasing price or fabrication cost, EC$)
Boat 1: __________
Boat 2: __________

8) How much do you spend, on average, on boat maintenance (including engine)? (EC$/unit time as easiest to specify).
Boat 1: ______/______
Boat 2: ______/______

9) When you need to repair your boat, do you do it yourself or you pay someone else to do it for you? (Open question)

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Note: if shared ownership or shared costs among crew, state whether answer corresponds to total expenditure or personal expenditure, and whether costs are shared evenly or not among owners/crew.
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10) For how long have you had your engine? (unit time as easiest to specify)
Engine 1: __________
Engine 2: __________

11) From this moment on, for how long do you think you will be able to use your engine until you have to replace it? (unit time as easiest to specify)
Engine 1: __________
Engine 2: __________

12) How much did your engine cost? (total purchasing price, EC$)
Engine 1: __________
Engine 2: __________

NOTES FOR SECTION B. I.:

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II. Fishing gear

1. What type(s) and how many fishing gear(s) do you typically use?

- ☐ Hand line #_____
- ☐ Pot/traps #_____
- ☐ Beach seine net #_____
- ☐ Bottom line #_____
- ☐ Bottom longline #_____
- ☐ Pole and line #_____
- ☐ Rod and reel #_____
- ☐ Gill net #_____
- ☐ Trolling #_____
- ☐ Spearfishing #_____
- ☐ Other (specify): __________ #_____

2. What factor(s) determine the type of fishing gear that you use?

☐ Season ☐ Fish targeted ☐ Cost of gear ☐ Efficiency ☐ Customer

☐ Other: _________

3. For how long are you usually able to use your gear until you need to replace it? (unit time as easiest to specify)

- ☐ Hand line #_____
- ☐ Pot/traps #_____
- ☐ Beach seine net #_____
- ☐ Bottom line #_____
- ☐ Bottom longline #_____
- ☐ Pole and line #_____
- ☐ Rod and reel #_____
- ☐ Gill net #_____
- ☐ Trolling #_____
- ☐ Spearfishing #_____
- ☐ Other (specify): __________ #_____

4. How much do you usually spend on gear(s)? (total purchasing price or fabrication cost in EC$ per trip, day, week, or as easiest to specify)

- ☐ Hand line _______/_______
- ☐ Pot/traps _______/_______

- ☐ Beach seine net _______/_______
- ☐ Bottom line _______/_______
- ☐ Bottom longline _______/_______
- ☐ Pole and line _______/_______
- ☐ Rod and reel _______/_______
- ☐ Gill net _______/_______
- ☐ Trolling _______/_______
- ☐ Spearfishing _______/_______
- ☐ Other (specify): _______/_______

5. Do you usually make your own gears, or do you buy them from someone else? (open question)
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6. When you buy your gears, where do you buy them? (open question)
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7. In case you need equipment from abroad, how do you get it? (open question)
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EXTRA NOTES FOR SECTION B. II.:

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III. Extras – operational expenditures

1. If boat fishing, how much money do you spend on fuel? (in EC$/ <u>per trip, per day or as easiest to specify</u>)
_______/_______

2. How many gallons of fuel do you buy per trip? (or as easiest to specify)
_______/_______

3. How much money do you spend on ice? (in EC$/ <u>per trip, per day or as easiest to specify</u>)
_______/_______

4. how many pounds of ice do you buy per trip? (or as easiest to specify)
_______/_______

5. How much money do you spend on bait? (in EC$/ <u>per trip, per day or as easiest to specify</u>)

_______/_______

6. How much money do you spend on crew/assistant(s)? Make clear how crew is paid. (in EC$/ per trip, per day or as easiest to specify)

_______/_______

Note: In case some of the above costs are shared, specify whether this is done evenly or not, and among how many people.

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EXTRA NOTES FOR SECTION B. III.:

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Section C: Catches, fishing effort and sales

1. Depending on the period (months) of the year, what species of fish do you target? What fishing gear do you use to target them? In case of static gears, can you provide an estimate of the usual soak time? If possible, also provide with an estimate of share of catch corresponding to each type of gear.

Period of the year	Targeted species	Fishing gear	Typical quantity of gear (number of rods, hooks on longline, pots, length of gillnet)	Typical soak time for static gears	Estimated contribution to annual earnings from fishing

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2. If boat fishing, how many trips do you make, on average, on a normal day? ______

3. On average, how many hours do you spend fishing…
    i. on a normal day? ______
    ii. on a bad day? ______
    iii. on a good day? ______

4. On average, how many days do you fish…
    i. on a normal week? ______
    ii. on a bad week? ______
    iii. on a good week? ______

5. If possible, do you go fishing on weekends?

6. On a normal week, how many of the trips that you make are registered by the data collectors of the fisheries department? ________

7. If fishing together with other fishermen:
    i. Do you typically keep your own catches, distribute common catches before sale, or distribute revenue from common catches after sale?
        - ☐ Keep my own catches
        - ☐ Distribute common catches
        - ☐ Distribute revenue from common catches

    ii. How many people do you usually fish with? __________

8. How many pounds of fish do you catch:
    i. On a normal day ________
    ii. On a bad day ________
    iii. On a good day ________

9. What percentage of the catches do you sell on a normal day? (Ask and make clear whether this corresponds to own catch, or total catch of the group) _____________

10. How many pounds of fish do you sell on a normal day? (Ask and make clear whether this corresponds to own catch, or total catch of the group) _____________

11. Who do you primarily sell your fish?

☐ Individuals ☐ Restaurants & hotels ☐ Middlemen ☐ Other: _________

12. What percentage of the catches do you keep for own consumption, on a normal day? (Ask and make clear whether this corresponds to own catch, or total catch of the group) ___________

13. How many pounds do you keep for own consumption on a normal day? (Ask and make clear whether this corresponds to own catch, or total catch of the group) __________

14. What percentage of the catches is given away or wasted on a normal day? (Ask and make clear whether this corresponds to own catch, or total catch of the group) ___________

15. How many pounds are given away or wasted on a normal day? (Ask and make clear whether this corresponds to own catch, or total catch of the group) ___________

NOTES FOR SECTION C:

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Section D: Potential activities/investments

What do you think should be done to support fishermen and/or fishing activities in Montserrat?

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Are there any facilities/investments lacking today, that you consider would be either useful or would bring new benefits to fishermen in Montserrat? How? (e.g. cooling facilities, fish processing plant)

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GENERAL NOTES:

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B. Interview schedule: restaurants owners

Federico Fraga, on behalf of Vrije Universiteit Amsterdam, Wolfs Company and JNCC.

INTRODUCTION: I am interviewing restaurants on Montserrat to learn more about the size and the importance of the fishing industry in Montserrat. Therefore, we are interested to learn amount the amount of fish you buy, your costs and revenue related to locally caught fish. This information will be used with the only purpose of finding out more about the true value and socioeconomic benefits of fishing for Montserrat. Any information from these interviews that is published or shared will be aggregated results, and will not include your name (it will be anonymous). Would you be willing to help me with my project by letting me interview you?

1. Number of people in your household (including yourself): __________

2. Is this your main source of income? __________

3. Number of days per week the restaurant is open: _____

4. Number of months per year the restaurant is open: _____

5. Do you serve lunch, dinner, or both?

- ☐ Lunch
- ☐ Dinner
- ☐ Both

6. How many pounds of fish do you buy…

a. On a normal day of catch ________

b. On a bad day of catch ________

c. On a good day of catch ________

7. How much money do you spend on fish …

a. On a normal day of catch ________

b. On a bad day of catch ________

c. On a good day of catch ________

8. Do you only buy local fish, or do you also buy imported fish at the supermarkets? If yes, could you provide an estimate of how much imported fish you buy? At what average price? What types? (on a weekly basis or as easiest to specify)

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9. If possible, could you provide detailed information on the type of fish you buy on a normal day?

Type of fish	Price of purchase (EC$/kg)	Quantity (kg / unit time)

10. How many fish meals do you sell, on average…

a. On a normal day for the restaurant? _______

b. On a bad day for the restaurant? _______

c. On a good day for the restaurant? _______

11. If possible, could you provide detailed information on the type of fish you sell on a normal day?

Type of fish meal	Quantity	Price of sale

12. How many normal, bad and good days do you usually have per week? Could you define what is a good, normal and bad day for the restaurant?

a. Normal: _____

b. Bad: _____

c. Good: _____

13. On the total meals you sell within a day, how many (on average) are fish meals? Alternatively, what percentage of your gross revenue corresponds to fish meals? (open question, let the interviewee respond as easiest)

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14. On a normal month (or as easiest to specify), what is your gross revenue? ________

15. On a normal month, how much ($EC) do you spend on …

i. Supplies

a. Food -if possible, excluding fish- ______

b. Beverages ______

ii. Wages/salaries _______

iii. Occupancy costs (e.g. rent, utilities, maintenance, insurance) ______

iv. Marketing/advertising _______

v. Taxes (excluding income taxes) ______

vi. Other costs (please, specify) _______

GENERAL NOTES:

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C. Interview schedule: fish cleaners

Federico Fraga, on behalf of Vrije Universiteit Amsterdam, Wolfs Company and JNCC

INTRODUCTION: I am interviewing individuals who clean fish on Montserrat to learn more about your activity. Any information from these interviews that is published or shared will be aggregated results, and will not include your name (it will be anonymous). Would you be willing to help me with my project by letting me interview you?

1. Number of people in your household (including yourself): __________

2. Is this your main source of income? __________

3. If there is fish available to be cleaned, how many days per week do you clean fish? _____

4. How many hours do you spend, on average, cleaning fish on a normal day? ______

5. Who do you clean fish for?

- ☐ Restaurants ____%
- ☐ Private consumers ____%
- ☐ Both _____%
- ☐ Other (specify) _______; ______%

6. How many pounds of fish do you clean for restaurants, individuals, etc…

a. On a normal day of catch ________

b. On a bad day of catch ________

c. On a good day of catch ________

7. How much do you charge to clean the fish, per pound? ________

8. Do you only clean fish when they bring it to you, or do you also buy fish, clean it and sell it afterwards?

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9. In case you buy, clean and sell it afterwards, could you give an estimate of the amount of fish you buy, in a normal day of catch? What price do you sell it after cleaning it? Who do you sell it?

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10. Do you clean the fish on your own, or with some other people?

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11. In case you clean with other people, how do you distribute your revenue?

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D. Catch corresponding to each type of fishery (% of total catch, 2016)

ID	Reef	Coastal Pelagic	Ocean Pelagic
1	98%	1%	1%
2	90%	5%	4%
3	100%	0%	0%
4	100%	0%	0%
5	10%	89%	0%
6	0%	100%	0%
7	100%	0%	0%
8	100%	0%	0%
9	94%	1%	5%
10	74%	1%	26%
11	98%	0%	2%
12	81%	19%	0%
13	n/a	n/a	n/a
14	85%	4%	11%
15	100%	0%	0%
16	87%	13%	0%
17	64%	36%	0%
18	100%	0%	0%
19	78%	13%	10%
20	55%	7%	38%
21	78%	1%	21%

E. Investments/policies mentioned by sampled fishermen and frequency

Investment/policies and frequency (x)	ID																		Total
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	
Harbour	x	x	x	x	x		x	x	x	x	x	x	x	x	x	x	x	x	17
Easier & cheaper access to equipment	x		x		x	x	x	x		x	x	x	x	x	x		x		13
Fish market	x					x		x			x	x							5
Boats & equipment storage and repair facility		x				x		x				x						x	5
Easier duty free process						x			x			x			x		x		5
Gas pump		x		x											x				3
Ice making facility								x					x				x		3
Duty free fuel															x	x			2
Traps robbery control			x							x									2
Promotion of youth engagement in fishing			x												x				2
Access to technologies			x																1
Fish storage facility													x						1
Safe anchoring									x										1
Fishing boundaries extension												x							1
Training													x						1
Fishermen formalization															x				1