A TOTAL ECONOMIC VALUATION OF THE WHITE RIVER SPECIAL FISHERY CONSERVATION AREA, ST. ANN, JAMAICA

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ABSTRACT

A Total Economic Valuation of the White River Special Fishery Conservation Area St. Ann, Jamaica

This study presents an economic assessment of the White River Special Fishery Conservation Area (WRSFCA), through quantifying the economic values of identified ecosystem services. The Total Economic Value (TEV) of the WRSFCA is computed to unravel the relationship between ecological vitality, societal well-being, and economic prosperity. Focused on primary benefits specifically for the White River community, including fishermen and coastal inhabitants, this concentrated approach is based on resource and time constraints.

For the 150-hectare SFCA, the findings reveal a substantial TEV approximating $USD500,000, highlighting the significance of diverse ecosystems within the WRSFCA. Shoreline protection emerges as the foremost ecosystem service, commanding a principal economic value (over USD$300,000), followed by fisheries (approximately USD$130,000). The valuation based on the community's willingness to pay (WTP) showcases a moderate economic value (USD$1335 per annum), mirroring their commitment to preserve the SFCA and its benefits. When contrasted against the interplay of ecosystem services, the seemingly modest valuation necessitates a more comprehensive analysis within a broader societal context.

Acknowledging limitations in predominantly relying on secondary data, this study emphasizes the need for a dual approach, integrating primary and secondary sources. The research highlights the pivotal role of sanctuaries in ecological enhancement and economic progress, advocating for increased government involvement in sustainable sanctuary management. The findings offer compelling grounds for governmental support and resource allocation towards the sustainable management of sanctuaries, reinforcing their crucial role in national development.

Keywords: economic assessment, ecosystem services, White River

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1. INTRODUCTION

1.1 The decline of Jamaica’s artisanal fisheries

The decline of Jamaica's fisheries shares striking similarities with the challenges faced by other countries across the Caribbean region. Many nations in the Caribbean have experienced a decline in fish stocks and the degradation of their coastal ecosystems. Factors such as overfishing, destructive fishing practices, habitat loss, pollution, and climate change impacts have been common contributors to this trend. The decline in fisheries has also imposed economic implications on various Caribbean countries; including reduced fish exports, increased imports to meet local demand, and thus a widening trade deficit.

As approximately 70% of Jamaica’s population reside within the coastal zone, there is great dependence on coastal and fisheries resources. Historically, Jamaica's fisheries industry supported the livelihoods of many Jamaicans over many generations, and significantly contributed to Jamaica's economic growth. However, the excessive dependence on fishing as a primary livelihood source, coupled with inadequate enforcement of regulations and limited capacity for effective fisheries management have further exacerbated the issue. The consequences are widespread, including reduced fish availability, diminished biodiversity, compromised ecosystem resilience, and negative socio-economic impacts on coastal communities.

The industry is predominantly comprised of artisanal fisheries (small-scale fishing), centered around the island’s shelf. In the case of fisheries as an environmental good, it is not valued in the economic market, and therefore, it is uncommon that any one individual can incur either the full benefit, or cost, of its environmental quality. Fisheries, regarded as a natural asset, can therefore be categorized as "common resources," and consequently leads to excessive usage, insufficient investment, and eventual degradation and exhaustion; which is an idea encapsulated by the "Tragedy of the Commons." concept. This phenomenon gives rise to economic complications, and eventually reduced resource availability over time, affecting both ecological function and societal welfare.

As a result of the dependence of artisanal fishing, a wide variety of Jamaica's shallow shelf or reef species are overexploited around the island shelf. Additionally, a number of other anthropogenic factors such as coastal development, land-based sources of pollution, unsustainable fishing practices and climate change have also contributed to diminishing fish stocks in Jamaica.

1.2 Special Fisheries Conservation Areas in Jamaica

With the combination of degraded marine ecosystems, increased pressure on fish stocks, and threats to the livelihoods of fisherfolk island-wide, it became necessary to revamp and implement strategies geared toward replenishing reduced stocks and conserving remaining stocks. The sustainable development of Jamaica's Fisheries required the balance between resource consumption and environmental protection. Special Fishery Conservation Areas (SFCAs), more commonly known as Fish Sanctuaries, are declared no fishing zones, with the intent to promote reproduction of fish populations. Under the Fisheries Act of 2018, it is illegal and therefore punishable by law to partake in fishing activities within those designated zones. The creation and effective management of SFCAs has shown to be a practical tool used for conserving fish stock and preserving biodiversity (Johnson et.al, 1999). The first few sanctuaries were established between 2009-2012, and since 2023, there are now a total of 18 fish sanctuaries around the island; totalling approximately 10,000 hectares of marine space that is protected by law (National Fisheries Authority, 2018).

Table 1: Number of SFCAs in Jamaica, their year of establishment and associated sizes in hectares.

Special Fishery Conservation Area	**Year of establishment**	**Area of protected space (ha)**
Bogue Lagoon Fish Sanctuary	2009	225
Bluefields Bay Fish Sanctuary	2009	1359
Boscobel Marine Sanctuary	2013	99
East Portland Fish Sanctuary	2016	620
Oracabessa Bay Fish Sanctuary	2010	84
Sandals Whitehouse Marine Sanctuary	2012	294

Discovery Bay Fish Sanctuary	2009	168
Three Bays Fish Sanctuary	2009	1261
Salt Harbour Fish Sanctuary	2009	1022
Galleon Harbour Fish Sanctuary	2009	1873
White River Fish Sanctuary	2017	150
Montego Point Fish Sanctuary	2009	303
Galleon St. Elizabeth Fish Sanctuary	2009	260
Orange Bay Fish Sanctuary	2009	536
South West Cay Fish Sanctuary	2009	1515

The Government of Jamaica (GOJ) established co-management arrangements (supported by formal Memorandums of Understanding) that delegate the day-to-day management responsibilities of SFCAs to local non-governmental organizations (NGO) and/or fishermen associations. The GOJ (National Fisheries Authority) maintains the authority and responsibility to gazette SFCA boundaries, and to establish and amend relevant regulations. Meanwhile, the local NGOs and/or fishermen cooperatives are responsible for daily patrols, enforcement of the Fisheries Act, and conduct monitoring when necessary.

In the Jamaican context, the establishment of SFCAs have shown both ecological and socio-economic benefits. For example, the Oracabessa Bay Fish Sanctuary, in 2019, had recorded over 10,000 planted corals through their restoration efforts, and had positively impacted over 50 local fishermen due to the increase in fish stock, having established the SFCA (Oracabessa Marine Trust, 2019). Another example is the Caribbean Coastal Area Management Foundation (C-CAM), which has boasted programmes that have targeted biodiversity conservation, through the establishment of three SFCAs on the South Coast of Jamaica, as well as management of dry limestone forest within the wider protected area, through the establishment of the Forest Conservation Council, consisting of several stakeholders including community members (C-CAM, 2023).

1.3 Research Goal and Objectives

This study utilizes a Total Economic Value methodology to provide a baseline economic assessment for goods and services of the ecosystems within the White River SFCA, 5 years after its establishment. This is as close of a baseline analysis as can be provided, given that no other economic data had been collected prior to this study. Due to time and resource limitations, it is important to note that this study will focus on associating a value to the main benefits provided by the White River SFCA to the White River community members (fishermen and other nearby coastal inhabitants). The aim of the project seeks to provide an economic assessment of the ecosystem services provided within the White River Special Fishery Conservation Area (SFCA), St. Ann, Jamaica, using the Total Economic Value transfer methodology. The objectives of this research project include:

1. To identify the ecosystem services provided by the White River SFCA.
2. To compile secondary data relating to economic valuation of the identified ecosystem services.
3. To extrapolate a total value that represents the ecosystem services provided by the White River SFCA, using the Total Economic Value transfer methodology.

1.4 Literature Review

1.4.1 Economic Valuation – Background

Human beings utilize the environment and its resources to further and improve their well-being and welfare. The functions of ecosystem services allow for improved socioeconomic factors, and increasing populations has led to the increased use of the environment to benefit from ecosystem services. In the case of environmental goods or ecosystem services, some are valued while for others there is no market, and as a result, markets often fail to produce an efficient result, because it is uncommon that any one individual can incur either the full benefit, or the cost, of a particular environmental quality. Environmental goods commonly suffer from the presence of externalities or a lack of property rights.

With a lack of property rights, resources can be considered as “common”, meaning that no such individual or organization has claim to the resource, and therefore it is subject to overconsumption, under-investment, and ultimately deterioration and depletion.

This concept is known as the “Tragedy of the Commons” and leads to economic problems; in that the self-interest to use the resource results in less of the resource in the long term, to the disadvantage of everyone. Marine resources within the White River (Jamaica) area were an example of tragedy of the commons. Additionally, ecosystem services within the area were being negatively impacted by anthropogenic factors, such as pollution, overfishing, coastal development and climate change. Consequently, this had led to an overall reduction in ecological function, and depleted fisheries (reduced, smaller catch by the local fisher-folk).

Economic valuation can be defined as the estimation of a number value for amenities or services (Garrod and Willis; 1999, O’Mahoney; 2021). This concept can be applied to several societal aspects such as policies, projects, and more relevant to this research, natural resources, by evaluating their benefits and costs to society, and addressing market inefficiencies. Economic studies can contribute to the debate about MPAs as a management option by evaluating their benefits and costs to society. Monetary valuations of the environment have become a major topic in many economic books and articles, as the concept of environmental trade-offs for human well-being should idealize “win-win” scenarios where biodiversity is conserved, and human well-being is promoted (Mcshane et. al; 2011).

The United Nations (1987) defines sustainability as actions that ensure the needs of the present are met without compromising the ability of future generations to meet their own needs. Sustainable management of natural resources involves three dimensions; economic, social and ecological. Achieving sustainability is hinged on the fact that future human well-being is determined by current management of capital stocks (Soderqvist et. al, 2005) which provides returns that are essential to human well-being; thus maximizing human welfare. Examples of capital stocks include social, cultural and natural services. Based on research done by Garrod and Willis (1999); while there are several benefits to consider when focusing on the natural environment, such as ecological, socioeconomic, aesthetic and others; methods to evaluate the monetary aspect of environmental degradation against development benefits has been increasingly used to advise policies to ensure environmental protection and maximization of human and society welfare.

Coastal ecosystems play a vital role, especially for Small Island Developing States, such as the South Pacific islands and the Caribbean region. They provide services that include food (fisheries), shoreline protection, as well as recreational and cultural activities (O’Garra; 2012). Ecosystem services are defined by Daily (1997) as processes and systems derived from the natural environment that can sustain human life. The Millennium Ecosystem Assessment (2005) categorized ecosystem services into 4 groups that are crucial to maintaining human wellbeing; namely provisioning services (food, water), regulating services (water purification, climate regulation), supporting services (nutrient cycling, primary production), and cultural services (recreation, education). These services are essential to human welfare; but the sustainability issues associated with population expansion and increased rates of urbanization have affected their function, and in many cases, their existence. Although the benefits from coastal ecosystems are numerous, SIDS tend to focus their efforts on poverty reduction and economic growth (Ashe; 2005); over conserving those valuable resources, and again resulting in market inefficiency.

With increased pressure on coastal ecosystems and the demand for ecosystem services (tragedy of the commons), conducting an economic valuation can convert ecosystem services into a metric that allows for comparisons within the market, can demonstrate the tangible economic benefits associated with the protection of a particular natural resource, as well as, providing data when considering environmental conservation policies (Naidoo; 2003). Natural resource valuation allows natural resource managers and policy makers to make more informed decisions regarding utilization of resources to support human well-being; and ultimately a sustainable environment. Scientists and economists have emphasized technical challenges in associating monetary values to natural resources and ecosystem services (Gomez-Baggethun; 2011, McCauley; 2006, Kallis et.al; 2013). In fact, Wiley (2003) explained that the users of the natural resource, on an individual basis, will tend to have a higher value for the resource than non-users, but it is in the aggregation of the values of non-users that this category of values realizes its magnitude.

Constanza et. al (1997) distinguishes two terms; ecosystem services and ecosystem function; where ecosystem services are described as goods and services that can directly or indirectly provide benefits to human populations through ecosystem functions, and the latter refers to the biological processes within ecosystems. The study, which focuses on valuing ecosystem services of the world's biomes, has grouped these services into 17 main categories. Examples include water supply, climate regulation and food production. The valuation included a variety of methods (based on the ecosystem service) as well as synthesized information from previous studies. The study also notes limitations in estimating economic values to ecosystem services; some of which include a lack of total representation of services due to categories that are not adequately studied or even unknown, inaccuracies to willingness to pay (WTP) values due to societal influence and other factors.

Table 2: Ecosystem Services (Constanza et. al; 1997)

#	Ecosystem Goods/Service	Ecosystem functions	Examples
1	Gas regulation	Regulation of atmospheric chemical composition	CO_2/O_2 balance, O3 for UVB protection, and SO_x levels
2	Climate regulation	Regulation of global temperature, precipitation, and other biologically mediated climatic processes at global or local levels	Greenhouse gas regulation, DMS production affecting cloud formation.
3	Disturbance regulation	Capacitance, damping and integrity of ecosystem response to environmental fluctuations	Storm protection, flood control, drought recovery and other aspects of habitat response to environmental variability mainly controlled by vegetation structure
4	Water regulation	Regulation of hydrological flows.	Provisioning of water for agricultural (such as irrigation) or industrial (such as milling) processes or transportation.

5	Water supply	Storage and retention of water.	Provisioning of water by watersheds, reservoirs and aquifers.
6	Erosion control and sediment retention	Retention of soil within an ecosystem.	Prevention of loss of soil by wind, runoff, or other removal processes, storage of stilt in lakes and wetlands.
7	Soil formation	Soil formation processes	Weathering of rock and the accumulation of organic material.
8	Nutrient cycling	Storage, internal cycling, processing and acquisition of nutrients.	Nitrogen fixation, N, P and other elemental or nutrient cycles.
9	Waste treatment	Recovery of mobile nutrients and removal or breakdown of excess or xenic nutrients and compounds.	Waste treatment, pollution control, detoxification
10	Pollination	Movement of floral gametes.	Provisioning of pollinators for the reproduction of plant populations
11	Biological control	Trophic-dynamic regulations of populations	Keystone predator control of prey species, reduction of herbivory by top predators.
12	Habitat	Habitat for resident and transient populations	Nurseries, habitat for migratory species, regional habitats for locally harvested species, or overwintering grounds.

13	Food production	That portion of gross primary production extractable as food.	Production of fish, game, crops, nuts, fruits by hunting, gathering, subsistence farming or fishing.
14	Raw materials	That portion of gross primary production extractable as raw materials.	The production of lumber, fuel, or fodder.
15	Genetic resources	Sources of unique biological materials and products.	Medicine, products for materials science, genes for resistance to plant pathogens and crop pests, ornamental species (pets and horticultural varieties of plants).
16	Recreation	Providing opportunities for recreational activities	Eco-tourism, sport fishing, and other outdoor recreational activities.
17	Cultural	Providing opportunities for non-commercial uses.	Aesthetic, artistic, educational, spiritual, and/or scientific values of ecosystems

1.4.2 Economic Valuation in the Jamaica context

Research shows that the use of economic valuation methods for protected areas in Jamaica has been employed, including Dolphin Head Forest Reserve, Portland Bight Protected Area, Montego Bay Marine Park and Black River Morass; to document and provide information on the value of the nation's natural resources, especially within protected areas. Cesar et.al (2000) studied the Portland Bight Protected Area (PBPA); Jamaica's largest conservation area, which includes both terrestrial and marine natural resources. The project's purpose aimed to value ecosystem services provided by the protected area, and to provide justification toward the benefits overweighing the costs/expenses associated with managing the area. Direct uses of the PBPA were identified as pelagic and demersal fisheries, forest products, while indirect uses included tourism and coastal protection. In relation to fisheries, benefits of direct use were calculated at approximately US$ 6.7 million (average fish price of US$2.8/ kg^{-1}). For forest products, the use had been valued at US$100,000. In terms of tourism, use of the PBPA's resources were estimated at nearly $US 5 million for the entire protected area. Lastly, the valuation of coastal protection by the PBPA was calculated to be US$400,000 per year. In comparing the costs and benefits of the PBPA, Cesar et.al (2000) reported that the benefits largely outweigh the costs by more than double.

1.4.3 Natural Resource Valuation methodologies

In terms of economic valuation, there are a variety of methods that can be applied, depending on the type of service. Total Economic Value (TEV) is defined by Adger et. al (1995) as the amount of resource, expressed in a monetary unit, that society would not have access to if those resources were lost. The formula can be expressed as the following:

TEV = Direct-use values + Indirect-use values + Option value + Existence value

On the North-east coast of Jamaica, the White River Special Fishery Conservation Area (WRSFCA) was established in 2017 and has operated with the aim of restoring marine biodiversity within the protected area. The 150-hectare sanctuary encapsulates one main fishing community, as well as a plethora of hotels and private vacation homes and villas along the coastline. Based on the categories of ecosystem services outlined by Constanza (1997), Table 1 below illustrates the ecosystem services provided by the WRSFCA, and the valuation methods that can be used to capture value of the named ecosystem services.

1.4.4 Application of EV methods to Ecosystem Services

O'Garra (2012) conducted an economic valuation study of the goods and services provided by a declared marine protected area (MPA) called Navakavu, in Fiji; with an objective to determine to what extent coastal resources should be further utilized. Total Economic Value (TEV) is defined in this study as the economic value of all goods and services provided by an ecosystem. The methodology involved a fisheries valuation, a contingent valuation (WTP/WTA) and benefits transfer for valuing coastal protection. Based on the results and the assumption that the TEV of an ecosystem is equal to the total of the aforementioned components, the study concluded that coastal protection provided by coral reefs contributes the greatest to the TEV (55%), followed by fisheries (44%), and then bequest values (1%). O'Garra (2012) also highlighted limitations to the study; including restrictions to fisheries catch data, the target audience for the contingent valuation questions and more.

Hicks et.al (2009) studied the economic value of goods and services associated within three different coral reef management areas (government-managed, community and government co-management and on the south coast of Kenya, Africa. Ecosystem goods and services were grouped into three broad categories; namely direct use (fisheries), indirect use (waste regulation, coastal protection) and non-use values (bequest, existence, option). Through this study, it was concluded that the highest total economic values were linked to areas with significant government interventions in management. The study also noted that different services contributed to the TEV in different ratios. The government-managed and co-managed sites had equally high TEVs, which the authors deduced that tourism development (non-use values) can contribute a high economic value with or without an established marine park or protected area. In contrast, the sites with government management had the lowest levels of community-based socio-economic values. As the White River SFCA is based on a community and government co-managed model, this study can be used to infer that such a management model can result in a relatively high TEV.

1.5 Site Description

The White River SFCA is a 150 hectare "no-take" zone, established in 2017, and possesses a unique characteristic, in that the 30km long river empties directly into the middle point of the designated area (Figure 1) . The White River is also used by the fisherfolk for a variety of reasons; including the river providing a safer area to dock their boats during adverse weather conditions, and the majority of the immediate coastline being privatized by hotels.. The identification of the WRSFCA was based on a number of social and ecological criteria. One of the key criteria is the presence and involvement of "at least one functioning Non-Government Organization (NGO) that will operate the sanctuary and enforce the regulations protecting it. The WRSFCA became the result of a joint partnership between the White River Marine Association (WRMA) which consists of hoteliers, concerned residents and other interested parties, and the White River Fishermen Association (WRFA), consisting of over 30 members that depend on the White River area for their livelihoods.

Marine resources within the White River area were an example of tragedy of the commons. Additionally, ecosystem services within the area were being negatively impacted by anthropogenic factors, such as pollution, overfishing, coastal development and climate change. Consequently, this had led to an overall reduction in ecological function, and depleted fisheries (reduced, smaller catch by the local fisher-folk).

Figure 1: Google Earth image showing boundaries of the WRSFCA.

The main ecosystems found within the boundaries of the SFCA include seagrass beds and coral reefs (fringing, patch). A baseline marine assessment of the WRSFCA conducted in 2017 revealed a significant finding, indicating that a majority percentage of macroalgae, surpassing 50%, was present across six sites located within and around the protected area. The National Environment and Planning Agency (NEPA) has conducted coral reef assessments around the island, revealing the presence of algal dominant reefs, similar to was observed within the White River area. Utilizing the coral reef health index (CRHI), NEPA’s evaluation of Jamaica's coral reefs in 2017 showed their overall condition to be "poor" with a CRHI rank of 2.3 (NEPA, 2017). Furthermore, researchers also observed a concerning prevalence of dead coral accompanied by the growth of algae (Waldron, 2017). However, amidst these challenges, it was noted that the dedication of stakeholders and other collaborators holds immense potential for bringing about substantial improvements in the area. With concerted efforts, the protection and restoration of the ecosystem could be achieved, ensuring the long-term health and vitality of the marine environment.

In comparison, the marine assessment conducted in 2022 showed an encouraging development as coral cover had increased by 28% (CMS, 2022). This positive trend signified a potential for increased ecological and economic benefits. The growth of coral reefs plays a vital role in supporting biodiversity, providing habitats for various marine species, and contributing to the overall health of the ecosystem. Moreover, the restoration of coral reefs can have significant economic impacts by attracting tourism, supporting local livelihoods, and enhancing the resilience of coastal communities. Therefore, the observed increase in coral cover presents a promising outlook for the future, highlighting the importance of continued efforts and collaboration in the preservation and restoration of the marine environment.

2. METHODOLOGY

2.1 Data Collection

The economic value of all goods and services provided by an ecosystem constitutes the TEV of an ecosystem. Table 1 highlights the categorization of ecosystem services based on the resources within the White River SFCA, along with methods used to value each.

Table 3: Ecosystem services provided by the WRSFCA and their associated valuation methodologies.

Coastal resources within White River SFCA	Category of Ecosystem Services	Ecosystem Services	Valuation methodology
Coral reefs	Regulating Cultural Provisioning	Coastline protection Recreation Fisheries	Benefit transfer method
Seagrass beds	Regulating	Carbon sequestration	
Marine biodiversity	Provisioning	Fisheries (finfish, invertebrates)	
Bequest Value			Contingent Valuation (survey with White River community members)

With the use of existing studies (Waldron, 2017; Blake, 2017; CMS, 2022), and qualitative information from community members who have anecdotal knowledge of the area, the acreage of the SFCA and the most important goods/services provided by the White River SFCA were identified as fisheries, coastal protection afforded by coral reefs, carbon sequestration provided by the seagrass ecosystem, recreational value and bequest value. However, given the potential for double-counting for fisheries (from both coral reef and marine biodiversity), this study did not incorporate a marine biodiversity value into the TEV of the area.

Having identified the ecosystem services, spatial dimensions of benthic ecosystems (coral reef and seagrass beds, shoreline) within the SFCA were determined using GIS software. GPS coordinates were obtained in the field and transformed into polygons on Google Earth to determine the extent of each ecosystem. The polygons were measured and added, to determine full acreage. A benthic distribution map was then created illustrating the spatial dimension of coral reefs, seagrass beds as well as an outline of the shoreline that is used for local recreation.

Additionally, non-use values were identified in terms of willingness to pay for future generations to access the ecosystem services based on input by the White River community members, collected via 7 sets of focus groups (6 persons each).

2.1 Natural Resource Valuation methodologies

Benefit Transfer Method

The Benefit Transfer Method is explained by Plummer (2009) as the application of economic value estimates of ecosystem services within an area by transferring information from previous studies with similar characteristics . This method can therefore be applied to a variety of ecosystem services, and in this study, was applied to coastal protection, carbon sequestration and fisheries. A unit value, which is represented by a dollar estimate and expressed as a constant per-unit amount, was derived from previous studies on similar sites. Studies with similar sites were chosen based on correspondence to socioeconomic and biophysical characteristics to the SFCA. The per-unit amount was then multiplied by the acreage (space) of WRSFCA.

Contingent Valuation

The Contingent Valuation Method (CVM) is the most commonly applied method in the context of estimating the value of a non-market good/service. A great advantage of contingent valuation is the ability to provide information and describe the trade-off precisely (Blomquist, 2001). In the case of this study, ecosystem services within and surrounding the WRSCFA were valued by the fishermen’s willingness to pay (WTP) to maintain the ecosystem services provided by the area. Data collection to apply this method involved direct questioning of the individuals and was elicited through focus groups, between May and June 2023.

2.3 The Ecosystem Service Valuation Database (ESVD)

The Ecosystem Service Valuation Database (ESVD) is a comprehensive and standardized repository of information on the economic valuation of ecosystem services. It serves as a central resource for researchers, policymakers, and practitioners interested in understanding the monetary or non-monetary value of ecosystem services provided by nature. The main purpose of the ESVD is to compile, organize, and synthesize studies that have quantified the economic value of ecosystem services across different regions and ecosystems worldwide. The ESVD provides a structured framework for gathering information related to ecosystem service valuation studies. This includes details about the study design, geographical location, ecosystem type and valuation methods used. The database also facilitates the comparison and synthesis of valuation results, allowing for meta-analyses and meta-regression analyses to identify patterns and general trends across studies.

For this purpose of this study, The ESVD was utilized as a valuable resource to gather relevant articles for my research on valuing ecosystem services within the White River SFCA. Through the database's search functionalities and filters, there was specific emphasis on articles related to similar ecosystems and valuation methods that align with the characteristics of the White River SFCA. With the information gathered from these studies, the benefit transfer method was applied, which involves transferring the estimated economic values from existing studies to the White River SFCA context. This method enabled the estimation of monetary estimates for the ecosystem services provided by the White River SFCA, based on the findings and insights from the studies within the ESVD.

2.4 Data Analysis

Data analysis involving regression analysis on metadata gathered from economic assessment studies conducted on marine spaces provided valuable insights into the economic value of marine ecosystems. By examining various economic indicators and variables, regression analysis allowed for the identification of relationships and trends within the data. Data on value/ha/yr and income from a sample of independent studies and obtained information on the country's GDP per capita from secondary data sources (collated via the ESVD).

The log-log transformation was applied to ensure that the relationship between value/ha/yr and income was captured in a linear form, consistent with economic theory. Using statistical software, the regression analysis was performed to estimate the income elasticity of each ecosystem service. The income elasticity quantifies how much the ecosystem service value changes in response to changes in income.

The R-squared value that was generated was used to assess how well the regression model fits the data. Statistically significant tests, such as the p-value for the coefficient estimate and the F-statistic in the ANOVA table were calculated to ensure the results are statistically significant. The coefficient estimate was also used to understand the impact of ecosystem value on the country's GDP per capita.

3. RESULTS

The analysis of collected data using GIS software revealed that coral reefs were the prevailing ecosystem within the sanctuary, surpassing seagrass in terms of acreage (Table 4). The findings showcased the dominant presence of coral reefs, indicating their substantial coverage and ecological significance in the area. Conversely, seagrass was observed to be relatively limited and scattered throughout the SFCA (Figure 2), indicating its smaller overall extent compared to the extensive coral reef habitats.

A log-log regression model was used to analyze how people's willingness to pay per hectare per year (WTP/ha/yr) changes based on their income, for each ecosystem service. The results from this analysis were consistent with economic theory. With reference to the sample calculation, the calculated income elasticity for Fisheries was found to be 0.53 (Table 5), suggesting that Fisheries is not highly sensitive to changes in income and can be considered inelastic. The regression model revealed a strong connection between the independent variable (income) and the dependent variable (WTP/ha/yr). This is supported by the high R-squared value, which means that a large proportion of the variation in WTP/ha/yr can be explained by changes in income. Additionally, the p-value for the coefficient estimate is significant, indicating that the relationship between income and WTP/ha/yr is not due to random chance. The goodness of fit of the model was further confirmed by the low standard error, which means that the estimated values are accurate and close to the actual values. The F-statistic in the ANOVA table also showed significance, supporting the overall suitability of the regression model. Overall, the coefficient estimate suggests that the value of Fisheries per hectare per year has a positive and statistically significant impact on the country's GDP per capita, based on the secondary data collected.

White River fishermen were asked to express their willingness to contribute monetarily to secure access to White River's ecosystem services for future generations. The results exhibited a noticeable trend in the category of responses. A significant majority of respondents (67%) showed a positive inclination, answering "Yes" to the question (Table 6). Of those positive responses, a majority of 39% indicated that they'd contribute $JMD5000 on an annual basis (Figure 3). A smaller percentage (14%) responded with "No" and "Depends on which entity receiving funds," suggesting some reservations in their willingness to contribute, while 5% of the participants stated "Don't know," indicating a lack of certainty on the matter.

For each resource, the economic value associated with ecosystem services such as fisheries, carbon sequestration, recreation, and other related benefits. The combination of the values of all the assessed ecosystem services generated an estimate of the total economic value (TEV) of the White River SFCA. This evaluation (exclusive of a Tourism value), as shown in Table 7, yielded a total economic value of $USD491,686.72

Figure 2: Ecosystem resources within the White River SFCA.

Table 4: Calculated acreage of ecosystems within the White River SFCA

Ecosystem	**Calculated Acreage**
Coral reefs	17.6 ha
Seagrass	3.9 ha
Beach front (recreational/public access)	0.2 ha

Sample Calculation:

Fisheries:

Collated value data from 40 protected areas within North America

Calculated per hectare amount = $USD 7,483.06

Therefore, using the Benefit Transfer method, total value of ecosystem service (Fisheries):

$USD 7,483.06 x 17.6ha = $131,701.86

Table 5: Regression statistics for collated Fisheries metadata

Multiple R	**0.9357093831**
R Square	0.8755520496
Adjusted R Square	0.849911024
Standard Error	0.9079020349
Observations	40

ANOVA					
	df	*SS*	*MS*	*F*	*Significance F*
Regression	1	226.1709	226.17094	274.3840283	5.65803E-19
Residual	39	32.14716	0.8242861		
Total	40	258.3181			

	Coefficientandard Err		*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*	*Lower 95.0%*	*Upper 95.0%*
Intercept	0	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
4.21	0.53749	0.032448	16.564541	3.04264E-19	0.471854884	0.603119691	0.471854884	0.603119691

Table 6: White River community members' willingness to pay (WTP)

Category of responses	**Percentage of respondents (%)**
Yes	67
No	14
Depends on which entity receiving funds	14
Don't know	5

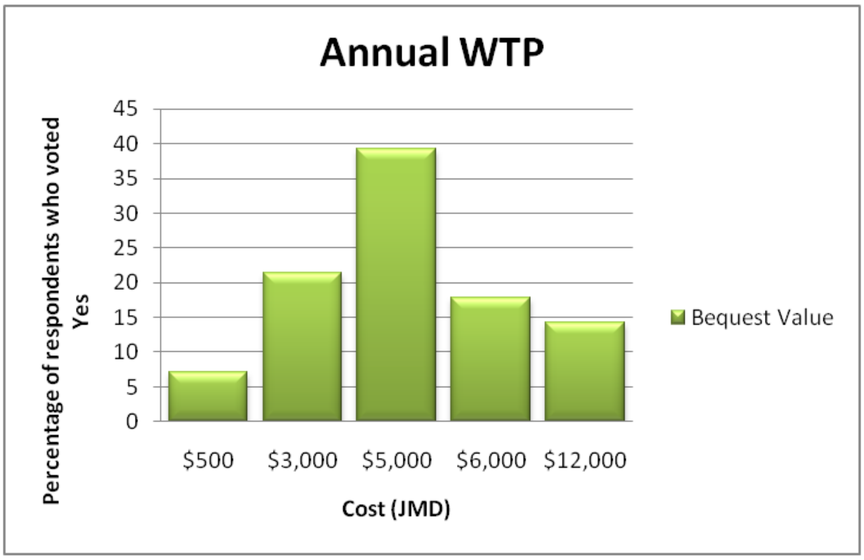

Figure 3: Dollar amounts that White River fishermen would be willing to pay annually to maintain the SFCA.

Table 7: Estimated values for associated ecosystem services within the White River SFCA.

Ecosystem within the White River SFCA	***Resource Use***	***Potential Annual Revenue ($USD)***
Coral Reef	Fisheries (local consumption)	131,701.86
	Shoreline Protection	312,301.08
	Tourism	**not included in this study*
Subtotal		*444,002.94*
Seagrass	Carbon sequestration	45,515.15
Subtotal		*45,515.15*
Cutlass Bay (White River beach)	Recreation	813.63
Subtotal		*813.63*
Bequest Value: Wllingness to Pay (WTP)	Continued management and preservation of the SFCA	1,355.00**
Subtotal		*1,355.00*
TOTAL		**491,686.72**

*Limited time and resources to collect relevant data

**Exchange rate:USD1:JMD155

4. DISCUSSION

One potential explanation for the significant degradation of the marine environment due to human activities could be related to an incomplete comprehension of its intrinsic worth. This oversight can be attributed partly to the limitations of current economic assessment frameworks, which often overlook non-market-related values (Manero et.al, 2022). This research paper sought to assess the Total Economic Value (TEV) of the White River Special Fishery Conservation Area (SFCA), using a structured methodology involving secondary data sources. The research objectives encompassed the identification and quantification of various ecosystem services contributing to the TEV, including use values such as fisheries and shoreline protection, as well as non-use values like bequest values associated with the SFCA's preservation. A combination of quantitative surveys and economic models was used to estimate these values, ensuring a holistic understanding of the SFCA's economic significance. The results of the study present calculated values for each ecosystem service, including fisheries, carbon sequestration, recreation, and others, to estimate the monetary worth of the SFCA's contributions to human well-being and the environment.

The findings revealed that the 150-hectare SFCA offers a substantial economic value to society. The total estimate of almost $500,000 USD highlights the significance of the area in supporting local livelihoods and enhancing the overall economic prosperity of the region. Examined through the lens of effective management, the economic values unveiled by this study showed a promising trajectory for the White River SFCA, aligning seamlessly with its overarching goal of bolstering fish stocks. The considerable contribution of artisanal fisheries underscores the importance of the SFCA as a vital resource for sustaining coastal communities and providing a source of income and food. Similarly to other publications (Constanza et.al, 1997; Lorenzo et.al, 2016; Spurgeon, 1992; Moberg and Folke, 1999), improved fisheries are one of the most common outputs of an effectively-managed protected area.

While a comparatively lower value for carbon sequestration as an ecosystem service , the significance assigned to the process also highlights the White River SFCA's pivotal role in addressing climate change; one of the most pressing global challenges. Within the sanctuary's ecosystem, the seagrass beds and intricate coral reefs work against rising carbon dioxide levels and their resultant effects. Functioning as indispensable carbon sinks, these seagrass beds and coral reefs engage in a natural process of carbon capture and storage.

Through photosynthesis, seagrasses absorb atmospheric carbon dioxide, locking it away within their organic structures (Macreadie et,al, 2014). To a lesser extent, the coral reefs, with their intricate architecture built upon the accumulated calcium carbonate, serve as repositories for carbon dioxide absorbed from the surrounding waters. As carbon dioxide is a key driver of climate change, the SFCA's contribution in mitigating its impacts is invaluable. Furthermore, the valuation of carbon sequestration, while a concept gaining increasing recognition, presents a nuanced challenge, in that assigning economic value to the SFCA's role in absorbing carbon dioxide is underpinned by intricacies, factoring in the unique specifics that may differ based on each protected area or national economy. The economic value attributed to the recreational aspect within the SFCA highlights its potential as a hub for local recreation, ecotourism and outdoor pursuits. This dimension not only serves to invigorate local economies through the inflow of tourism-derived revenues, but it also plays a pivotal role in nurturing an enhanced admiration and ownership for the area's innate natural aesthetics. This, in turn, serves as a catalyst for fostering conservation endeavours and the adoption of sustainable practices, fostering a more profound understanding of the interconnectedness between human actions and the environment (Rahman, 2021). Presently, there exists a framework of small-scale local recreational activities, encompassing ventures such as jet-ski rides and snorkelling. However, the unregulated nature of these activities complicates the accurate assessment of their impact on the sanctuary's ecosystems. The potential ecological consequences, positive or negative, remain ambiguous due to the absence of a structured regulatory framework that could systematically monitor and manage these activities.

Simultaneously, the ecosystems within the SFCA have evolved into a larger-scale attraction for tourists. Large hotel chains and private villas, along the shoreline of the SFCA, have recognized the magnetism of the sanctuary's ecosystems and have capitalized on it as a prominent tourist attraction. This acknowledgment from the commercial sector further proves the diverse dimensions of this SFCA's economic value, acknowledging its role as a tourism beacon. It is noteworthy, that while this study casts a spotlight on the local and community-level benefits generated by the SFCA, the broader tourism-oriented appeal is also indicative of the sanctuary's multifaceted nature. The study highlights the direct benefits of the SFCA on local residents and the immediate White River community, accentuating its role in enhancing livelihoods and fostering economic prosperity.

Shoreline protection stands as a crucial and multifaceted ecosystem service, particularly for coastal communities, similar to White River. This essential service is rooted in the capacity of natural ecosystems to act as barriers, mitigating the adverse impacts of coastal erosion, storm surges, and natural disasters such as hurricanes. In the context of White River, the absence of mangrove ecosystems, which are renowned for their exceptional protective attributes (Ewel et. al, 2008; Sandilyan and Kathiresan, 2015), has increased the susceptibility of the local community to damages from storm surges and other natural disasters. This void magnifies the significance of the other ecosystems present within the SFCA. The interplay of seagrass beds, coral reefs, and other ecological components gain renewed importance as they assume the role of providing a degree of shoreline protection that would have otherwise been mostly conferred by mangroves. In fact, shoreline protection as an ecosystem service yielded the highest value within the SFCA (over USD$300,000). The intricate synergy between these ecosystems acts as a natural buffer, absorbing the impact of wave energy and reducing the potential for erosion and destruction of infrastructure, and as such, further exacerbates the importance of continued conservation and management efforts within the SFCA. It is important to note that the shoreline protection service is further compounded by the presence of substantial infrastructure clustered along the SCFA's shoreline, consisting of hotels, villas, and other related constructs. The multifaceted reach of shoreline protection extends not solely over the local community, but encompassing the tourism sector as well. Therefore the White River SFCA fortifies local resilience, and simultaneously contributes to the vitality of the national economy through the tourism industry.

The Contingent Valuation Method (CVM), predicated on the White River community's willingness to pay (WTP), provided a unique lens of the perceived value of the diverse ecosystem services rendered by the WRSFCA. Despite the multifaceted services that the SFCA offers, the community attributed a relatively modest economic value to these contributions. The quantified annual amount, standing at $1355 USD, reflects the sum the White River community is willing to contribute to uphold the SFCA's continued existence and its benefits. The seemingly low valuation, when juxtaposed with the complex interplay of ecosystem services should be dissected within a broader context.

One potential explanation for this apparent paradox could be rooted in the complex interplay of economic, cultural, and social factors. The relatively low valuation might not necessarily indicate an underappreciation of the SFCA's contributions but could be a reflection of the various factors that underpin individual and communal valuation decisions. For example, societal priorities, financial constraints, and competing demands on community resources may all influence the value assigned to the SFCA's offerings. The study also indicated that some fisherfolk expressed reservations or uncertainty regarding their willingness to contribute monetarily to secure access to the ecosystem services for future generations. This was based on a lack of trust with Government sectors with regard to providing and managing the accrued funds. This highlighted a potential barrier to conservation efforts and the involvement of the community in the SFCA management. Moreover, the CVM, while insightful, might not fully encapsulate the entirety of the SFCA's worth. The intrinsic value of the sanctuary, such as cultural heritage and aesthetic value, provide intangible benefits and transcends economic parameters, and is therefore challenging to capture within a singular monetary metric.

Based on the study's bequest value, it is recommended that the implementation of Payment for Ecosystem Services (PES) by the Government of Jamaica could present a promising avenue to bolster community support and advance the management of the WRSFCA. Payment for Ecosystem Services (PES) is a market-based environmental conservation approach that involves compensating individuals or communities for managing, preserving, or restoring ecosystems and the services they provide. By introducing a tangible economic benefit linked to conservation endeavours, PES amplifies the perceived importance of these actions, promoting increased involvement from the White River community in safeguarding the SFCA. Specifically to White River, PES holds the potential to elevate the livelihoods of local residents, who often rely on the benefits of the SFCA for their livelihoods. Through the diversification of income sources facilitated by PES, community members can experience diminished pressure to excessively exploit marine resources, thereby contributing to the long-term health of the ecosystem. PES initiatives also foster a more robust partnership between the SFCA management (Government and NGO) and the community. Through meaningful involvement in decision-making processes, the community is granted a participatory role in shaping conservation strategies that harmonize with their requisites and principles, which in turn can have the potential to mitigate conflicts, increase adherence to regulations, and instill a shared sense of accomplishment in safeguarding the SFCA's ecosystem.

Conducting an economic assessment of the White River SFCA using secondary data offered valuable insights, but also entailed inherent limitations that warrant consideration. Firstly, the reliance on existing data sources may have resulted in information gaps, incomplete datasets, or outdated figures. These limitations could potentially compromise the comprehensiveness of the economic evaluation, leading to an incomplete representation of the actual value of ecosystem services. They also emphasize the importance of complimenting such analyses with primary data collection. Combining both approaches ensures a more robust and accurate understanding of the economic value of the White River SFCA's ecosystem services. Furthermore, while secondary data can provide a baseline, it might not capture potential changes or developments in the SFCA's ecosystem services over time. Changes can be influenced by various factors, such as climate change, human activities, and policy interventions. Failing to account for such changes can limit the accuracy and relevance of the economic assessment.

Another limitation pertains to the specific context of the White River SFCA. Ecosystems and their economic values can vary significantly across countries, and secondary data might not fully capture the unique characteristics and dynamics of the White River SFCA. This contextual mismatch can lead to overly generalized estimations, potentially misrepresenting the SFCA's true economic worth. The exploration of the White River SFCA illustrates the intricate interconnectedness between nature's offerings and human interactions. This study serves as a reminder that economic valuation, while a valuable tool, should coexist with a profound appreciation of the broader context in which ecosystems flourish.

Overall, the results underscore the critical role of the White River SFCA as a valuable natural asset, providing a range of ecosystem services that contribute significantly to the economy and the well-being of both current and future generations. These findings have important implications for policymakers and conservationists, highlighting the need for sustainable management strategies to ensure the continued provision of these valuable ecosystem services and the preservation of the SFCA's ecological integrity. Continued research and monitoring efforts will be essential to better understand the dynamics of the ecosystem services and their changing values over time, facilitating informed decision-making and effective conservation measures. The SFCA's economic assessment illuminates the delicate balance between conserving ecological integrity, empowering local communities, and promoting economic growth. Moving forward, it calls for continued stewardship, a more nuanced understanding of ecosystem dynamics, as well as improved advocacy on the value of natural ecosystems.

5. CONCLUSION

In conclusion, the study aimed at quantifying the Total Economic Value (TEV) of the White River Special Fishery Conservation Area (SFCA). This undertaking stands as a pioneering effort, representing a baseline analysis that addresses the notable absence of prior economic data. Recognizing the constraints of time and resources, this study prioritized the quantification of the primary benefits bestowed by the SFCA upon the White River community, particularly its fishermen and adjacent coastal inhabitants. Using the TEV and benefit transfer methodology, the study's objective hoped to highlight the economic underpinnings of the SFCA's offerings, translating their environmental significance into tangible economic metrics.

Results revealed a calculated TEV approximating USD$500,000. This figure boasts more than a numerical representation; it symbolizes the profound interconnectedness and significance of the diverse ecosystems encapsulated within the SFCA. Through this economic lens, the study paints a picture of how each ecosystem service, from fisheries support to carbon sequestration and shoreline protection, works and collaborates harmoniously, contributing collectively to the economic value of the White River community. In spite of the services offered by the SFCA, the community assigned a comparatively subdued economic valuation to these services. The measured annual sum, fixed at $USD1,355., delineates the extent to which the White River community is inclined to invest in preserving the SFCA's existence and its associated advantages. This seemingly modest valuation, when contrasted against the interplay of ecosystem services, necessitates a more comprehensive analysis.

This comprehensive economic assessment serves as a tool to emphasize the pivotal role of the WRSFCA, and other sanctuaries across Jamaica. It showcases the multifaceted significance of these protected areas, not only in ecological enhancement but also as drivers of economic progress for the nation. Moreover, these findings provide compelling evidence to engage relevant governmental bodies, explaining the need to channel increased investments into the management and preservation of sanctuaries around the island. By highlighting the tangible benefits that stem from such conservation efforts, this assessment propels a compelling case for the alignment of ecological conservation with economic growth, fostering a sustainable path forward for Jamaica's natural and societal well-being, in alignment with Goals 3 and 4 of Vision 2030 Jamaica (PIOJ, n.d).

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7. APPENDICES

Appendix 1: Ecosystem coverage within the White River SFCA.

Area in Hectares		
Seagrass patches	Coral reef	Beach front for recreation
0.3	1.8	0.2
0.34	1	
0.54	1.18	
0.09	0.18	
0.22	0.19	
0.35	0.28	
0.26	0.67	
0.41	0.51	
0.19	0.56	
0.38	0.43	
0.43	0.83	
0.27	1.46	
0.02	0.25	
0.06	0.52	
0.13	0.09	
Total 3.99	0.24	
	0.29	
	0.67	
	0.8	
	0.46	
	0.68	
	0.33	
	1.34	
	1.22	
	0.62	
	0.88	
	Total 17.58	

Appendix 2: Secondary data valuations on shoreline protection as an ecosystem service collected from the Ecosystem Service Valuation Database (ESVD).

Ecosystem Service	Country	Beneficiaries	Site Area in Ha	Int$/Hectare/Year	GDP per capita	Year of publishment	CPI Calculations$ for 2023
Coastal protection	Bonaire, Sint Eustatius and Saba	General population			16175.34053	2012	
Coastal protection	Cayman Islands	General population		244.0539	69534.77191	2017	329.14
Coastal protection	Belize	General population			16175.34053	2011	
Coastal protection	St. Vincent & the Grenadines	Household	11.25	1482.3175	16175.34053	2015	1938.89
Coastal protection	St. Vincent & the Grenadines	Household			16175.34053	2015	
Coastal protection	St. Vincent & the Grenadines	Household	11.25	969.2076	16175.34053	2015	1267.74
Coastal protection	St. Vincent & the Grenadines	Household	2.5	56592.936	16175.34053	2015	74024.11
Coastal protection	St. Vincent & the Grenadines	Household			16175.34053	2015	

Coastal protection	St. Vincent & the Grenadines	Household	2.5	48050.606	16175.34053	2015	62850.66
Coastal protection	USA	Residents			59914.7778	2021	
Coastal protection	Puerto Rico	Residents			16175.34053	2021	
Coastal protection	USA	Residents			59914.7778	2021	
Coastal protection	USA	Residents			59914.7778	2021	
Coastal protection	Puerto Rico,	Residents			16175.34053	2021	
Coastal protection	USA	Residents			59914.7778	2021	
Coastal protection	USA	Residents			59914.7778	2021	
Coastal protection	Puerto Rico,	Residents			16175.34053	2021	
Coastal protection	USA	Residents			59914.7778	2021	
Coastal protection	France,	Residents		3455.9051	59914.7778	2017	4350.37
Coastal protection	Martinique		5000	16193.3522	16175.34053	2015	21181.06
Coastal protection	Jamaica		1530	5660.6451	16175.34053	1998	10707.98
Coastal protection	USA		34400	298.9414	59914.7778	2012	403.16
							Avg. 17744.38

Appendix 3: Secondary data on valuations for Fisheries as an ecosystem service collected from the Ecosystem Service Valuation Database (ESVD).

Ecosystem Service	Country	Beneficiaries	Site Area in Ha	Int$ Per Hectare Per Year	GDP per capita (2017)	Value Year	CPI calculations$ for 2023
Fisheries	Bonaire	General population	2700	31.16	16,175.34	2012	41.94
Fisheries	Bonaire	General population	2700	13.13	16,175.34	2012	17.67
Fisheries	Martinique	General population	5000	401.49	16,175.34	2015	524.15
Fisheries	Jamaica	General population	1530	652.28	9,984.58	1998	1,231.54
Fisheries	Jamaica	General population	135600	80.95	9,984.58	2000	146.32
Agriculture and wetland products		General population	7000	477.99		1998	902.47
Recreational fishing		General population	7000	215.87		1998	407.57
Fisheries		General population	1095.8887	21,162.08		1990	50,680.86
Recreational fishing		General population	38802.0687	42,140.12		1997	80,812.88
Recreational fishing		General population	174527.1582	6,388.42		1997	12,251.19
Support of commercial fisheries		General population	109439.5429	510.16		1989	1,285.34

Recreational fisheries		General population	109439.5429	4,342.52		1989	10,940.89
Commercial fisheries		General population	328012.6864	253.24		1989	638.03
Recreational fisheries		General population	328012.6864	657.33		1989	1,656.13
Support to oyster production		General population	45000	1,065.32		1978	5,200.62
Value of small scale catch		General population	100000	65.27		2013	86.48
Support of commercial shrimp fisheries		General population	83500	160.6		1997	307.99
Nursery function, making a living,		General population	481	2,693.02		2002	4,639.55
Fisheries	USA	General population	1754	3,308.26	59,914.78	1989	6,246.16
Fisheries	USA	General population	1754	2,481.20	59,914.78	1989	4,684.63
Food	Belize	General population	3431200	7.92	16,175.34	2011	10.97
Food	Cayman Islands	General population	23000	106.63	69,534.77	2016	137.32
Food	Mexico	General population	49158	416.12	20,032.41	2018	512.22

Food	Bermuda	General population	55000	29.75	81,834.96	2007	44.84
Food	Bermuda	General population	20000	340.83	81,834.96	2007	513.75
Food	Mexico	General population	1000000	434.75	20,032.41	2015	567.57
Food	USA	General population	349849	33.89	59,914.78	1997	64.99
Food	USA	General population	349849	73.67	59,914.78	1997	141.28
							Avg. 7,483.06

Appendix 3: Secondary data on valuations for Recreation as an ecosystem service collected from the Ecosystem Service Valuation Database (ESVD).

Ecosystem	Ecosystem Service Recreation-related services	Country	Beneficiaries	Site Area in Ha	Int$/Hectare/ Year	GDP per capita	Year of publishment	CPI calculations for 2023
Coral reefs; Sandy shorelines	Beach recreation	St Vincent & the Grenadines	General population	2.5	32033.7373	13633.04812	2015	41900.43
Coral reefs; Sandy shorelines	Beach recreation	St Vincent & the Grenadines	General population	11.25	741.1588	13633.04812	2015	969.44

Seagrass	Local transport	Bonaire	Tourist	4830	3.999	16175.34053	2014	5.21
Seagrass meadows	Accommodation	Bonaire	Tourist	4830	157.5858	16175.34053	2014	205.95
Seagrass meadows	Car/scooter rental	Bonaire	Tourist	4830	59.0886	16175.34053	2014	77.22
Seagrass meadows	Donations	Bonaire	Tourist	4830	4.92	16175.34053	2014	6.43
Seagrass meadows	Diving, snorkelling, fishing		Tourist	4830	109.4726	16175.34053	2014	143.06
Coral reefs; Seagrass meadows	Diving	Bonaire	Tourist	2730	3.8163	16175.34053	2014	4.99
Coral reefs; Seagrass meadows	Snorkeling	Bonaire	Tourist	2730	4.6267	16175.34053	2014	6.04
Coral reefs; Seagrass meadows	Boat rental	Bonaire	Tourist	2100	44.1235	16175.34053	2014	57.66
Coral reefs; Seagrass meadows;	Trail/Marine park tag	Bonaire	Tourist	2730	9.629	16175.34053	2014	12.58
Coral reefs; Seagrass meadows	Harbour fees	Bonaire	Tourist	2784	4.3738	16175.34053	2014	5.71
Seagrass meadows	Airport fees	Bonaire	Tourist	2730	19.7043	16175.34053	2014	25.74
Seagrass meadows		Bonaire	Tourist	4830	135.4336	16175.34053	2014	176.99
Seagrass meadows	Shopping	Bonaire	Tourist	4830	44.9345	16175.34053	2014	58.72

Sandy shorelines	Recreation and tourism	Bonaire	Tourist	1300	30.2591	16175.34053	2014	39.55
Seagrass meadows	Sport fishing	Martinique		5000	802.9761	16175.34053	2015	1050.31
Seagrass meadows	Ecotourism	Martinique		5000		16175.34053	2015	8752.51
Coral reefs; Seagrass meadows	Diving	Bonaire	Divers	2600	14.3675	16175.34053	2006	22.15
Coral reefs; Seagrass meadows	Diving	Bonaire	Divers	2600	16.3064	16175.34053	2006	25.14
Coral reefs; Seagrass meadows	Diving	Bonaire	Divers	2600	954.9875	16175.34053	2006	1472.17
Coral reefs; Seagrass	Diving	Bonaire	Divers	2600	1928.7002	16175.34053	2006	2973.20
Coral reefs; seagrass	Diving	Bonaire	Divers	2600	2209.5789	16175.34053	2006	3406.20
Coral reefs; Seagrass meadows	Diving	Bonaire	Divers	2600	7.0864	16175.34053	2006	10.93
Coral reefs; Mangroves	Tourist trip expenditure	Jamaica	Tourist	124000	27357.2902	16175.34053	2008	39619.47
Coral reefs; Mangroves	Tourist user fees	Jamaica	Tourist	124000	2432.237	16175.34053	2008	3522.43
Coral reefs; Mangroves	Tourist environmental tax	Jamaica	Tourist	124000	3088.2136	16175.34053	2008	4472.42
								Avg. 4068.72

Appendix 4: Secondary data on valuations for carbon sequestration as an ecosystem service collected from the Ecosystem Service Valuation Database (ESVD).

Ecosystem	Ecosystem Service	Countries	Site Area In Hectares	Type Of Beneficiary	Int$/Hectare/Year	Year of Publishment	CPI calculations for 2023
Mangrove	carbon storage,	Honduras	169	local residents	2995.817	2017	3771.20
Mangrove	carbon storage,	Honduras	169	local residents	1496.326	2017	1883.61
Mangrove	carbon storage,	Honduras	169	local residents	995.0883	2017	1252.63
Mangrove	carbon storage	Cuba	2631.3	global	143.2071	2016	184.78
Mangrove	carbon stocks	Costa Rica	13450	local residents	29.7171	2015	38.87
Coral reef, seagrasses, beach	Carbon sequestration	Martinique	2000		133.8294	2015	175.05
Coral reef, seagrasses, beach	Carbon sequestration	Martinique	5000		133.8294	2015	175.05
Mangrove forests	Carbon sequestration	Mexico,	605000		37.8767	2020	44.89
Mangroves	Climate regulation	United States of America	16000000		71680.68	2012	96671.91
Mangroves	Carbon sequestration of mangroves	Jamaica	5500		13246	2000	23988.05
Estuary	Carbon sequestration	United States of America	70400	residents	154.0889	2018	190.04
							Avg. 11670.55

Appendix 5: Focus Group questions for Contingent Valuation of WRSFCA

1. How have environmental changes affected fishing patterns and their livelihoods?
2. Given the current status of Jamaica's artisanal fisheries, do you think future generations will have it easier or harder to catch fish?
3. What has your experience of fishing been, since the establishment of the WRSFCA?
4. On a scale of 1-10, how willing are you to pay a fee to ensure that you continue to benefit from the provisions/outputs of the WRSFCA? Give an example of how much you'd be willing to pay.
5. Do you/your family use White River recreationally?
6. What aspect of the surrounding White River environment is important to you and your livelihood?
7. Beside the environment, what else in this community is important to you?