ECONOMIC VALUATION OF MANGROVES IN TAWI-TAWI ISLANDS, SOUTHERN PHILIPPINES: A MARKET PRICE AND CONTINGENT VALUATION APPROACH

RYAN B. ROLDAN

Faculty of Management and Development Studies

U.P. OPEN UNIVERSITY 2022

UNIVERSITY OF THE PHILIPPINES

OPEN UNIVERSITY

Master of Environment and Natural Resources Management

RYAN B. ROLDAN

ECONOMIC VALUATION OF MANGROVES IN TAWI-TAWI ISLANDS, SOUTHERN PHILIPPINES: A MARKET PRICE AND CONTINGENT VALUATION APPROACH

Faculty of Management and Development Studies

January 2022

Permission is given for the following people to have access to this special problem: Available to the general public	Yes
Available only after consultation with author/thesis/dissertation adviser	No
Available only to those bound by confidentiality agreement	No

Student's Signature: ______ January 2022___

Signature of Special Problem Adviser: ______________

UNIVERSITY PERMISSION PAGE

“I hereby grant the University of the Philippines a non-exclusive, worldwide, royalty free license to reproduce, publish and publicly distribute copies of this special problem in whatever form subject to the provisions of applicable laws, the provisions of the UP IRR policy and any contractual obligations, as well as more specific permission marking on the Title Page.”

“Specifically, I grant the following rights to the University:

a) To upload a copy of the work in the special problem database of the college/school/institute/ department and in any other databases available on the public internet;

b) To publish the work in the college/school/institute /department journal, both in print and electronic or digital format and online; and

c) To give open access to above-mentioned work, thus allowing “fair use” of the work in accordance with the provisions of the Intellectual Property Code of the Philippines (Republic Act No. 8293), especially for teaching, scholarly and research purposes.”

RYAN B. ROLDAN

ACCEPTANCE PAGE

This special problem titled "**Economic Valuation of Mangroves in Tawi-Tawi Islands, Southern Philippines: A Market Price and Contingent Valuation Approach**" is hereby accepted by the Faculty of Management and Development Studies, U.P. Open University, in partial fulfillment of the requirements for the degree Master of Environment and Natural Resources Management

PROF. MAE BELEN LLANZA PUTIAN — 8 March 2022

Faculty-in-Charge, Special Problem — (Date)

DR. CONSUELO DL. HABITO — 9 March 2022

Program Chair, Master of Environment and Natural Resources Management — (Date)

Finaflor F. Taylan

OIC Dean, Faculty of Management and Development Studies

22 March 2022

Date

ABSTRACT

ROLDAN, RYAN BANTAYONON. Master of Environment and Natural Resources Management. Faculty of Management and Development Studies. University of the Philippines Open University. January 2022. **Economic Valuation of Mangroves in Tawi-Tawi Islands, Southern Philippines: A Market Price and Contingent Valuation Approach.**

Special Problem Adviser: Prof. Mae Belen Llanza Putian

This study focused on the economic valuation of mangroves in the province of Tawi-Tawi in Southern Philippines. Mangroves are recognized as a provider of a variety of products and essential ecosystem services that contribute significantly to the livelihood of local communities. However, mangroves forests in the area are being neglected as an important ecological function and service apart from providing goods to the communities. Mangroves are being harvested with not as much knowledge on how to protect, restore and conserve for the future's well-being. The study calculates the economic value of mangroves present in the area through estimation of Total Economic Value (TEV) using market price and contingent valuation method technique. The TEV will help identify and quantify the contribution of mangrove ecosystem services to the population in the Tawi-Tawi Islands. The study used Willingness to Pay (WTP) to calculate the Non-Use Value (NUV), specifically, Bequest Value to gather the people's willingness to pay for a hypothetical proposed project that will help conserve, preserve and protect the mangroves in their area using climate change scenario. The Total Economic Value (TEV) of mangroves in Tawi-Tawi are computed using local market price surveyed from the 50 respondents who are directly linked to the livelihoods of the mangrove forest system. Here, the estimated Total Economic Value (TEV) of mangrove benefit was identified. Market prices, replacement costs, benefits transfer value, and cost-benefit analyses have been used for value determination and comparison. The results showed that the TEV per year of mangroves in Tawi-Tawi, Philippines is ranging from 36,255,856 USD/year to 53,353,223 USD/year or 3,216 USD/year per hectare to 4,733 USD/year per hectare. The highest value contribution derived from the indirect use value (89.92%), whereas willingness to pay (WTP) results showed that high level of WTP at PHP 992 or 19.84 USD per household which indicates that the communities are willing to make spending for the proposed project to protect the mangroves in their area. Nonetheless, with the number of respondents who are unwilling to pay, efforts should be carefully considered to promote sustainable projects which can benefit the local people as well as the mangrove forest system. The local government unit should reflect into local awareness about climate change issues, whereas, the importance of mangroves should be enhanced to get the local communities involved in mangrove conservation and protection increase knowledge and trust at the household level. Finally, further research to explore the socio-demographic roles of the mangroves in the area to the local communities is recommended.

DECLARATION

I hereby declare that this special problem represents my own work which has been done after registration for the degree of Master of Environment and Natural Resource Management at the University of the Philippines-Open University and, has not been previously included in a special problem submitted to this or any other institution for a degree, diploma, or other qualifications. I have read the University's current research guidelines and, accept responsibility for the conduct of the procedures in accordance with the University's Committee guidelines in writing special problem.

RYAN B. ROLDAN
JANUARY 2022

ACKNOWLEDGMENT

The author expresses his gratitude to the people who became a significant part of his journey upon completion of this study.

To Prof. Mae Belen Llanza Putian, adviser, for suggestions and guidance in the stages and improvement of this paper.

Dr. Consuelo L. Habito, program chair and member of the panel, for consideration in complying with school requirements.

To Co-workers, from Pax Libera Mining Inc., for the support and assistance throughout this journey of graduate studies.

To batchmates, Maricor Montalbo, Bonifacio Jubay, Nicolle John Dela Cruz, Cherry Holgado, Eduard Palay and the departed Kayden Pandatu, for the support system and virtual memories. To forever friendships.

To Vicenta Roldan and Loreto Roldan, parents, for the inspiration to continue aiming for life’s significant purpose.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

Figures **Page**

List of Appendices

Chapter I

INTRODUCTION

1.1 Background of the Study

Mangroves are of great ecological importance to the coastal area and, as a habitat for tropical and sub-tropical marine biodiversity. These trees are mostly restricted to tropic and sub-tropic at latitudes between 30^{o} N and 30^{o} S (FAO, 2007). They offer marketable and non-marketable products as well as ecosystem services and functions to the nearby community as well as protection from natural disasters such as storms and large waves (Malik, Fensholt, & Mertz, 2015). In addition, these salt-tolerant evergreen trees that thrive in wetlands are effective agents for sediment trappings (Ilka, Friess, Krauss, & Lewis, 2017) and organic carbon storage (Ahmed, & Glaser, 2016). Sandilyan, & Kathiresan (2012) describes mangroves as one of the world's largest storage of biological and genetic diversity because of nutrient fluxes, productivity, and biodiversity of an organism.

However, there is a continuing threat of this rare type of forest due to the fast disappearance in various tropical countries. The main factor of mangrove deforestation can be accounted for anthropogenic activities (e.g., increase in population in coastal areas, overharvesting for timber and firewood, conversions to salt ponds, agriculture, and aquaculture) which causes a big shift in the natural biodiversity of the mangrove area. Mangroves are known to be of high biological efficiency as well as significant to the nutrient cycling of neighboring coastal waters. They provide protection from natural disasters such as storms and large waves (Malik, Fensholt, & Mertz, 2015). In addition, these salt-tolerant evergreen trees that thrive in wetlands are effective agents for sediment trappings (Ilka, Friess, Krauss, & Lewis, 2017) and organic carbon storage (Ahmed, & Glaser, 2016).

The loss of mangrove worldwide has concern over the severe disruption of the important ecological and economic functions that are normally present in an undisturbed mangrove system (Barbier, & Cox, 2003). Furthermore, mangrove carbon stocks when deforestation occurs cause the release of inorganic carbon into the atmosphere. Mangrove forest is a forest that rich source of life. The economic value of mangrove forests is very high for human welfare.

In the Philippines, Long and Giri (2011) noted the country as one of the largest mangrove-rich countries in the world. However, the conversion of mangrove areas to aquaculture and built-up areas is mainly causing the decline of mangrove cover (Primavera, 2000; Mendoza and Alura, 2001; Becira, 2006). The disappearance of mangroves in the country in the past decades took place sometime in the 1960s and 1970s during the same decades when aquaculture was highly encouraged by the government (Ferrer et al., 2011). The problem is being aggravated by the poor enforcement of many laws on mangrove protection (Primavera, 2000). Primavera et al. (2004) reported that there are 50–60 species of mangroves belonging to 16 families recorded around the globe. More than 50 of these are thriving in the Indo-Pacific and about 35 species are found in the

Philippines alone. Fringing mangroves in the Philippines are naturally lined by *Avicennia marina* and/or *Sonneratia alba* as front liners, with *Rhizophora stylosa* and *R. apiculata* closely behind. Additionally, mangroves in this region are dominated by ten (10) species namely: *Avicennia alba*, *Bruguiera gymnorrhiza*, *Ceriops tagal*, *Excoecaria agallocha, Nypa fruticans, Rhizophora mucronata*, *Rhizophora stylosa*, *Rhizophora apiculata*, *Sonneratia alba*, and *Lumnitzera racemose* (Primavera et al., 2012). It has been recommended that for any mangrove restoration project, species selection should match the physical characteristics of a given site. At present, there is a concerted effort by the government to rehabilitate degraded mangrove forests areas under the National Greening Program of the Department of Environment and Natural Resources (DENR).

In the Tawi-Tawi Islands South of the Philippines, the decrease of mangroves in the area has also been observed. Although the industrialization of the province has not been perceived as very fast compared to other places in the Philippines, the decrease of mangroves is likewise significant due to rapid timber and charcoal production, “agar-agar” or seaweed production, and mining activities. The economic direct values of mangroves in Tawi-Tawi are mostly focused on producing fish, timber, charcoal, nipa crafts, and tanbarks while some indirect services are focused on the protection of stilts houses near the area, seawater intrusion prevention, provision of nursery grounds, and carbon sequestration.

The economic valuation of mangrove resources and their ecological functions and services can be more than what is currently gained should there be an alternative use option. These resources can be of the potential increase of gain should there be an alternative use of its economic value. In other words, alternative management of mangroves must be properly evaluated to make rational choices between conserving and developing activities that may damage the forest resource. This necessitates the valuation of all costs and benefits of the different uses of the mangrove ecosystem. However, there are still no present studies regarding the economic valuation of mangroves in the province. The lack of resources regarding the economic valuation of mangroves in Tawi-Tawi islands was mainly because of a lack of experts to study in the area as well as the reputation of the Sulu archipelago which is known to have been at high risk of danger due to insurgencies.

1.2 Research Objectives

The study highlights the economic valuation of mangroves through estimation of Total Economic Value (TEV) using market price and contingent valuation method technique. These estimate benefits including estimations of Direct Use Value (DUV), Indirect Use Value (IUV), Option Value (OV), Bequest Value, and Existence Value will help to identify and quantify the contribution of mangroves ecosystem services to the population in the Tawi-Tawi Islands.

1.3 Scope and Limitations

Most of the formulas used for calculations were gathered from different resources such as journal articles and publications present on the internet while the interview of key informants for willingness-to-pay (WTP) used for economic valuation was done to calculate for the market prices and the amount of bequest value for total economic valuation.

Chapter II

REVIEW OF RELATED STUDIES AND LITERATURE

2.1 Economic Valuation of The Environment

The economic valuation of the environmental ecosystem which includes mangroves forest, coral reefs, wetlands, marshlands, and others aim to calculate the value of the loss of such habitats caused by land use and coastal congestion; reduction in coastal flexibility; and damage of nursery area for fisheries and its relative biodiversity (Debroy & Jayaraman, 2012). Setting down value on environmental goods and services is very significant for sustainable development. The problem with environmental economics on placing values on the assets is that because no market exists there is zero price on their true values which can only be shown upon buying and selling the goods and services. Since environmental goods and services often exist to users at a zero price, they appeared to be no effect on the markets and cannot be quantified as marketed goods. This is a serious issue for the reason that environmental goods and services have a positive value and not a zero price while many people are willing to pay to assure their sustained availability (Pearce et al., 1992).

Economists have been practicing the principle of cost-benefit analysis (CBA) in dealing with the efficiency of maximizing the benefits from scarce resources and using the net of the costs in each case. These principles of public investment and policymaking are widely used as a decision tool for concluding projects and policy proposals based on the magnitude of net economic benefits. However, the lack of capacity of the CBA to include many environmental benefits which do not enter the market or simply do not have economic benefits has made CBA inefficient projects and policies being selected. Many projects were carried out causing environmental damage and fewer projects for environmental benefit because the effects to the environment often go unrecorded in CBA. In effect, the biased result in project selection has led to the developments which can have some outputs to the market price and can be simply measured while partial against conservation options whose indirect benefits are not marketable and are therefore harder to measure (Bann, 1998). Given the circumstances, the people need to react to the decisions affecting environmental impacts. The economic value of environmental goods and services is vital to cover up the loss of ecological balance. Accounting for the broad spectrum of costs and benefits of projects is significant to manage the balance between a selection of good projects and projects which does not entail environmental damages.

2.2 Economic Valuation of The Mangroves

Mangroves contribute a significant part as the source of revenue for the coastal population. An economic valuation is a tool that determines both monetary (fisheries and forest products) and non-monetary gain (ecosystem services and functions) that mangroves provide people. It entails the functions of mangroves such as holding coastal defense functions, carbon storage, besides buffers to regulate nutrient fluxes, which indirectly influence the livelihood of people. The direct valuation above is impossible to calculate through simple scrutiny (Debroy, & Jayaraman, 2012). Individuals can assign a quantifiable combination of marketable and non-marketable values to a specific ecosystem on the place they reside. The economic valuation of natural resources highlights not only the rate of trade-off against a direct value that people perceived as valuable, rather emphasizes the totality of the natural changes of environmental goods and functions.

Economic valuation has greater potential to inform environment, social, and governance sustainability practices as well as land-use planning and coastal management practices. Coastal environments where mangroves strive are destructed by activities such as dredging, aquaculture ponds, pollution due to contamination of discharge, and poor land-use planning. These activities are driven by short-term gain instead of sustainable longevity of quality of life and nature (Wilson, Burke, & Lambert, 2015). By applying economic valuation to the mangroves ecosystem, accountability of all direct and indirect benefits from the mangrove' ecosystems and services are counted to be as important as the other benefits. This will also encourage long-term investment for sustainable management and provide a tool to support decision-making and guiding management. Furthermore, economic valuation establishes appropriate fees to be used in protected areas as well as set suitable values for damage compensation and biodiversity conservation.

2.3 Total Economic Valuation of The Mangroves

The total economic valuation of mangroves can be done using the diagram classified by Barbier (1993). The Total Economic Value (TEV) is classified into two parts as Use Values (UV) and Non-Use Values (NUV). The Use Values are further separated as Direct Use Values (DUV) and Indirect Use Values (IUV). The Direct Use Value is comprised of consumer products such as fish, forest products, and non-consumption products such as leisure from eco-tourism and gaming while the Indirect Use Value is comprised of benefits in the form of non-monetary and ecosystem function benefits such as off-shore fisheries, carbon sequestration, and storm protection (Figure 1).

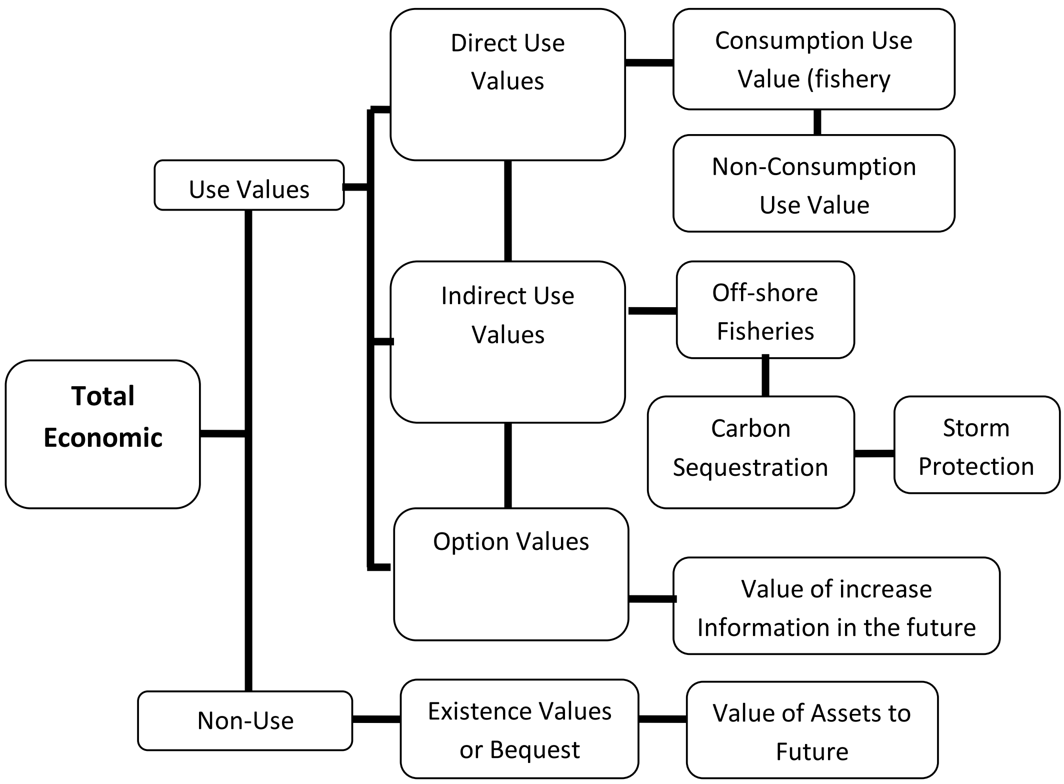


Figure 1: Components of total economic value. (Source: Barbier, 1993)

Numerous methodological approaches for valuing ecosystems/ natural resources based on the typology are presented by Barton (1994). The cost approach is mostly practiced since the benefits approach is relatively difficult to forecast. Some methods of cost approach are production analysis, benefit-cost analysis, and cost-benefits analysis. All of which are calculated through revenue from production. The definition of total economic value can be seen in Table 1 (Barton, 1994).

Table 1. Definition total economic value. (Source: Barton, 1994)

1	Direct Use Value	The economic value is derived from the direct use of natural resources/ecosystem.
2	Indirect Use Value	The economic value is derived from the indirect use of natural resources/ecosystem.
3	Option Value	The economic value is derived from the possible of direct or indirect use of natural resources/ecosystem in the future.
4	Bequest Value	The economic value is derived from the benefits of conserving natural resources/ecosystems for the benefit of future generations.
5	Existence Value	The economic value is derived from a perception that the existence of an ecosystem/resource exists, regardless of whether the ecosystem/resource is utilized or not.

2.4 Economic Contribution of Mangroves

The growing literature of ecosystem goods and services value have been growing especially from mangroves. Recently, rising studies from Asia have emphasized due to rapid deforestation in the region. Mangroves can provide many important economic values and services such as the following:

Coastal Protection

Mangroves are known to have the capability to help protect coastal communities and other associated structures against storms, tidal waves, and even routinely waves and surges. Because they can reduce wave height, their ability to minimize flooding and erosion are important factors that a healthy mangrove area can undertake. Mangrove forest reduces wind intensity as well as wave swellings up to 13% and 66%, relatively (Spalding, Ruffo, & Meliane, 2014). The wave height reduction can be associated with mangroves vary depending on the location of the area. The biophysical characteristics such as the width of the mangrove forest, water depth, density, and the types of the ocean floor are some of the variations that need to consider as to how far the mangroves can protect incoming waves hence reducing wave height.

Valuation for coastal protection of mangroves should consider the variation of routine waves and the possible scenario of impacts that a storm could damage. By calculating the economic values, practitioners should anticipate the value of mangrove forests related to storm protection. However, the variations depend on the type of built-up structure and other economic activities in the areas that are taking place.

Fisheries

Mangroves are a very important breeding ground for fishes and other associated marine creatures such as crabs, shrimp, and mollusks. The high yield and the increase in the production rate of numerous species in the mangroves have many benefits to the community as well as the mangrove ecosystem. Conducting valuation studies of mangroves is an important validation tool for management practices of fisheries and production. Since abundant fish production near mangroves is used for local consumers, it is important that obtaining the direct value of mangrove fisheries should be coming directly from the local instead of an open market to determine the actual and precise value of the mangrove fisheries.

Tourism

Ecotourism is one of the most emerging types of tourism that the world is investing in as of today and mangrove recreational activities are of them. Ecotourism has become an important economic driver in developing many services that mangroves provide by coastal ecosystems. The special link of terrestrial and marine ecosystems makes the mangrove ecotourism a unique place for environmentalists and science-conscious tourists for exploration. There are a lot of means to achieve the valuation of recreational-related mangrove ecotourism. The Direct Use Value is widely used as opportunity costs of tourists in different eco-sites to estimate its value. Contingent valuation is a substitute approach given that the data is not promising or hard to gather.

Soil Accretion

The accretion of soil sediments in the complex mangrove roots is very helpful in settling and accumulating the soil volume in the mangroves. This process also helps deposit organic matter from roots, leaves, and woods associated with the area. The growth of mangrove roots rises the soil deposits upward creating elevated soil levels (Spalding et al., 2014). Through this process, the rising sea level can be lessened by the mangroves.

Provisions

Communities near the mangrove area depend their livelihood on the mangroves such as harvesting timber and fuelwood collection. The economic valuation of these provisioning services is directly proportional to monetary values accumulated volume per year. The estimation uses the extracted market price per year multiplied by the sale and purchase minus the production cost. This can be collected by surveys and direct discussions with the associated stakeholders who are reliant on the mangroves as a source of revenue.

Nutrient and Sediment Filtering

Mangroves play important role ins sediment and pollution filtering from coastal runoffs. They produce clean water after filtering favoring every organism in its biome. Mangroves stocks heavy metal contaminants immobilizing the pollutants preventing them to spread in the coastal area. This valuation is yet to enter into economic valuation because of its complexities in giving value, thus very limited literature of this ecosystem service and function (Sandilyan & Kathiresan, 2012).

Carbon Sequestration

The presence of high-density organic carbon in mangrove forests can be a threat when subjected to rapid deforestation causing the potential release of carbon emission in the atmosphere (Hamilton, & Friess, 2018). The blue carbon sequestration of the coastal and ocean ecosystems is massive compared to other forest types. Mangrove sequestration is done in many processes such as new growth branches and trunks, growth of new roots, and through the roots as primary production, trapping sediments and organic material (Huxham et al., 2015). Assigning economic valuation from this ecosystem functions and services of mangroves forests is feasible following different mechanisms such as Clean Development Mechanism (CDM) and the Reducing Emissions from Deforestation and Forest Degradation (REDD) methodology. Estimates of carbon storage and sequestration through carbon credit benefit transfer values are used to calculate its economic value. The variation on the calculation of mean value will vary depending on the location, type of species, and strategic carbon sequestration.

2.5 *Valuation Methods applied for Mangroves*

A valuation is a survey-based method endorsed by numerous international organizations, such as the World Bank, and governments. It is a flexible and wide-ranging technique of estimating the demand for public services, and the economic value of environmental modification. For valuing ecosystem services, methods vary on the nature of the service it provides. While several substitute methods for price calculation that produce marketable goods and services for ecosystem functions are used to compute its economic value. Table 2 summarizes these services, as well as the methods most commonly used in their valuation. The production function approach (PF) is based on the idea that the environmental functions and services is an input to the production process and its value is calculated by its output on the productivity of marketed outputs (Barbier, 2000). PF measures the value of the environmental good depending on the change in consumer and producer surplus by the nature of its quantity and quality (Brander *et al.,*2006: Freeman, 2003).

The net factor income approach (NFI) calculates the cost of the environmental functions and services as the change in PS by taking away the cost of other production inputs from the total income of the marketable good. Market prices (MP) methods calculated direct value from the actual revenue of marketable goods and services of ecosystem services that it generated. However, MP estimates are often upward biased since the cost of other production inputs is neglected (Brander *et al.*, 2006). The market price method only takes into account use-values and marketing goods or services that have an actual price. Market price does not consider other indirect services which the environment provides. This limits the total valuation of the environment on a larger scale.

The contingent valuation method (CVM) comprises the use of surveys questionaires to elicit responses from people about their maximum willingness-to-pay (WTP) or willingness-to-accept (WTA) for hypothetical changes in environmental quality. The CVM estimates the compensating and equivalent surplus. The reasons for both respondents' willingness or unwillingness to pay are gathered to establish their different opinions which can be use in drawing conclusion.

Table 2. Ecological mangrove functions, economic goods and services, types of value, and commonly applied valuation methods.

Ecological function	Economic goods and services	Value type	Commonly valuation method(s) *
Flow and flood control	Flood protection	Indirect use	RCM MP
Storm buffering/ sediment retention	Storm protection	Indirect use	RCM PF
Water quality maintenance/nutrient retention	Improve water quality	Indirect use	CVM
	Waste disposal	Direct use	RCM
Habitat and nursery for plant and animal species	Commercial fishing and hunting	Direct use	MP NFI
	Recreational fishing and hunting	Direct use	TCM CVM
	Harvesting of natural materials	Direct use	MP NFI
	Energy resources	Direct use	MP NFI
Biodiversity	Appreciation of species existence	Non-use	CVM
Carbon sequestration	Reduced global warming	Indirect use	RCM
Natural environment	Recreation tourism	Direct use	CVM TCM
	Existence, bequest, option values	Non-use	CVM

Source: Adapted from Brander *et al.* (2006) who adopt with modifications from Barbier (1997), Brouwer *et al.* (2000), and Woodward and Wui (2001).
* Abbreviations represent: market prices (MP), production function method (PFM), travel cost method (TCM), contingent valuation method (CVM), replacement cost method (RCM), and net factor income (NFI).

Chapter III

METHODOLOGY AND DATA

Total economic valuation technique was used in this method. This method used to calculate the value of direct, indirect, non-used, and option benefit from the mangrove ecosystem in the Tawi-Tawi Islands. While some formulas for calculation were utilized from secondary data sources, sampling techniques for non-use values, specifically, Bequest Value of mangroves were analyzed using non-probability sampling using purposive sampling method under contingent valuation method.

3.1 Location of the Study

Tawi-Tawi province is the southernmost province in the Philippines composed of 300 beautiful islands and atolls in the Autonomous Region of Muslim Mindanao (Figure 2). It is located in the Sulu Archipelago between the Sulu Sea and the Celebes Sea, about 64 kilometers (40 mi) east of Borneo (TawiTawiIslands, 2019). The inhabitants are mostly speaking Sama–Bajau and Tausug languages of Muslim conviction with 390,715 as of 2015. The province is composed of 11 municipalities namely: Panglima sugala (Balimbing), Bongao (capital), Mapun (Cagayan de tawi-tawi), Simunul, Sitangkai, South Ubian, Tandubas, Turtle Islands, Languyan, Sapa-Sapa and Sibutu. Aside from tourism, Tawi-Tawi is the primary source of seaweed in the country. Roughly 80 percent of Tawi-

Tawians are earning from seaweed farming while others practice commercial fishing, mangroves timber, mining, and charcoal production. Dumilag (2019) identified commercial seaweeds species in local public markets of Tawi-Tawi namely agal-agal, latoh or gamay in Tausug, and gulaman in general local classifications. However, there are 7 identified species present in Tawi-Tawi commercial markets which are *Caulerpa lentillifera, Caulerpa cf. macrodisca ecad corynephora, Caulerpa cf. racemosa, Eucheuma denticulate, Kappaphycus alvarezii, Kappaphycus striatus, and Solieria robusta.* These species are vital in the local population for their daily diet and livelihood. Meanwhile, Muallila et al. (2020) reported a total of 266 species of reef fish in Tawi-Tawi with Epinephelinae (48 species), Lutjanidae (40 species), and Acanthuridae (33 species) as the most speciose groups. Furthermore, the study recorded 11 major commercially important coral reef fishes which are surgeonfish (family Acanthuridae), parrotfish (subfamily Scarinae, family Labridae), snapper (family Lutjanidae), grouper (subfamily Epinephelinae, family Serranidae), sweetlips (family Haemulidae), goatfish (family Mullidae), emperor (family Lethrinidae), triggerfish (family Balistidae), coral bream (family Nemipteridae), fusilier (family Caesionidae) and rabbitfish (family Siganidae). Tawi-Tawi had five times more unique species than species present in Palawan and Panay islands. In 2020, nationwide seaweed production amounted to 1.47 million MT valued at P10.6 billion, contributing 33.3% to total fisheries production (PSA, 2020).

Tawi-Tawi Island itself has an area of 108, 700 ha with a coastal length of 152,200 meters and 11, 272 ha total mangrove forest area (Mendoza-Viray, 2017).

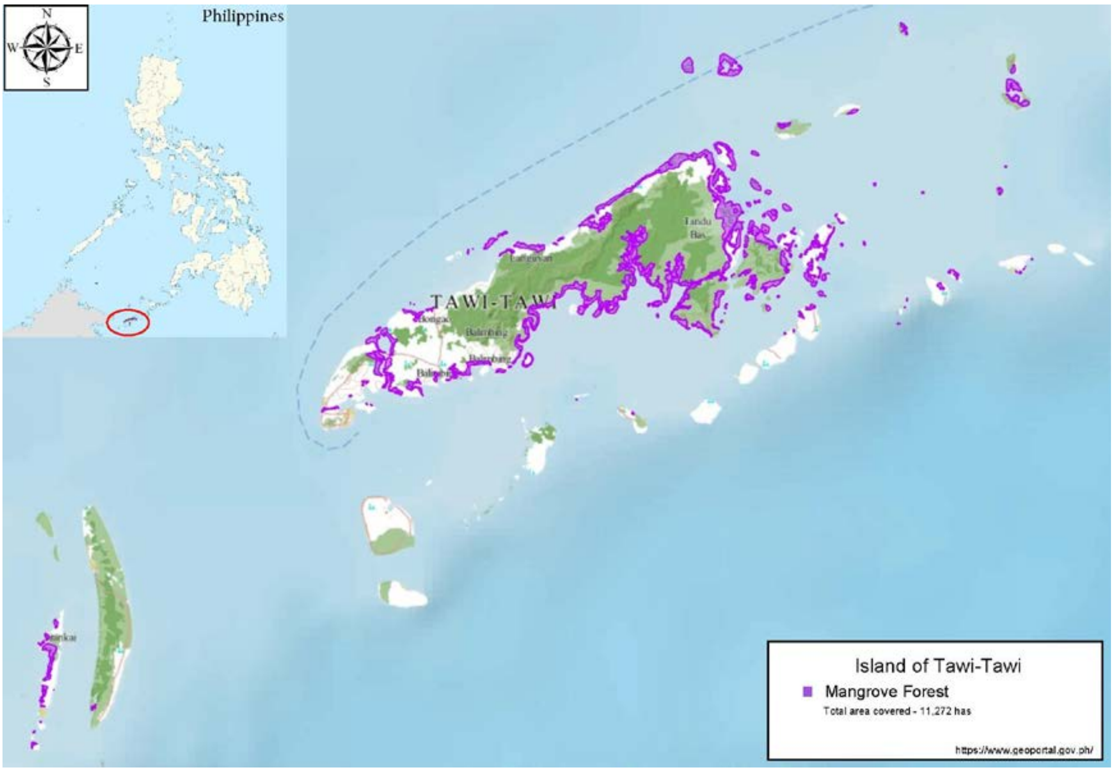


Figure 2. The Islands of Tawi-Tawi. (Source: GP. (2021). (https://www.geoportal.gov.ph/)

3.2 Materials and Data

Respondents Data Collection

There were a total of fifty (50) respondents sampled in this research study (Table 3). Household surveys using questionnaires were used to gather data on Direct Use goods of mangrove products using the average surveyed market price available through the amount earned per operation and the operational costs involved. While for Non-Use Value, specifically, Bequest Value was surveyed under willingness-to-pay (WTP). The form of questions comprised in the survey was correlated to (1) age, (2) household members, (3) education, (4) gender, and (5) livelihood/income. These determinants will be used as inputs to the identification of (6) Willingness to Pay (WTP).

Table 3. Description of Socio-demographic profile of the respondents.

Variable	Description	Unit of Measure
1. Age (Interval)	Age of the respondents	(1) 15-30 (2) 31-45 (3) 46-60 (4) 61- above
2. Household Size (Interval)	Number of family members residing at the house of the respondents	(1) 1-3 (2) 4-6 (3) 7- above
3. Education Attainment (Ordinal)	Educational attainment of the respondents	(1) Primary (2) Secondary (3) Tertiary level
4. Sex/Gender (Nominal)	Sex of the respondents	(1) Male (2) Female
5. Income (Interval)	Average monthly Income of the respondents	(1) 1-1000 (2) 1001-3000 (3) 3000- above
6. Willingness to Pay (WTP) (Nominal)	Refers to the questions with WTP choices	(1) Yes (2) No

There were Fifty (50) respondents selected under Purposive Sampling method (Patton, 1990) and all households selected were directly connected and dependent on mangrove forests in their area (fishermen, agar-agar, timber and tanbarks collectors, charcoal producers, and Nipa palm crafters).

The survey was conducted in the Municipality of Bongao and Languyan only. However, some selected respondents were coming from different municipalities that have commercial activities in the two commercial hub municipalities. The selection was due to reasons where Bongao is the main hub of commercialization while Languyan is where Mangroves are dominantly disturbed through timber, charcoal, and tanbarks production. The areas were selected due to the proximity of mangrove forests where fisheries and other forest products have been utilized for everyday consumption.

Willingness to Pay (WTP) of the Respondents

The survey questionnaire measures how much purchasing power the respondents are willing to give up to protect and conserve the mangrove forest in their area. Most of the residents in Tawi-Tawi are dominated by two Indigenous groups which are Tausug and Sama-Bajau. It was mostly expected that the survey information was hard to be recognized due to the high level of illiteracy and poverty while mostly relying on the availability of natural resources. The condition does not generalize the condition of all people living in Tawi-Tawi. However, it was being observed that most of the people relying on mangrove forests are those that being marginalized communities in the Tawi-Tawi islands. To help them understand this, the scenarios for the mangrove conservation and protection were also used to inform using research studies and expert's views about how to tackle the current situation. All of these questions were translated into Tausug format verbally so that the respondents were able to understand competently. While some were being personally interviewed to directly write their answers on the sheet.

The first scenario of the questionnaire was designed to comprehend respondents' understanding of the importance of mangrove ecosystem services, the effects of global climate change, and biodiversity protection. Preliminary interviews and discussions were also conducted to explain the problem and importance of mangroves in the area. This was also conducted to reduce the non-response rate and incompleteness of data. The major part of this section was to explain the importance of mangroves, the threats to mangrove forests, and the increase of sea level in the future due to climate change. In doing so, respondents were provided with adequate information to decide their valuation based on direct benefits (market price) and other non-use benefits that can be gained from the mangroves.

The proposed scenarios were conducted to survey residents. A climate change scenario is forecast that by 2030, Tawi-Tawi would experience a sea-level rise of 20 cm and the mangroves would be severely affected. It was also clearly stated the vulnerability of Tawi-Tawi will be highly likely given the current deforestation of mangroves in the area should it not be managed properly. Pictures of coastal erosion and mangrove biodiversity degradation and loss of fish catch were shown as a visual aid to help respondents understand how vulnerable Tawi-Tawi would be to sea level rise in the coming decade. The other scenario supposed a local project that would be carried out from now to 2030 and entail all locals to contribute money for protecting mangrove forests in Tawi-Tawi. Respondents were also asked the WTP questions to elicit individual preferences using an open-ended format in which respondents are asked directly what their WTP is, the no-bid value being suggested. Respondents were asked regarding their willingness to pay in a lump sum amount in cash for the project. If they are not willing to pay were also covered. If no, provide your reason why. Finally, information on socio-demographic conditions of the survey site was collected for statistical purposes and used as explanatory variables in the regression analysis.

3.3 Statistical Treatment and Data Analysis

The calculation for the Economic Valuation of Mangrove

The Total Economic Value (TEV) of mangroves was calculated from monetary values of the Direct-Used Value (DUV), Indirect-Used Value (IUV), Option Value (OV), and Non-Used Value of mangroves from Bann (1998), Pearce & Moran (1994), UNEP (2007), Sribianti (2008) and Ruitenbeek (1991). The TEV values were reported in percentage.

The DUV of mangroves was derived from benefit values of fishery and “agar-agar” products (fish and seaweeds) and forestry products (timber collection, tanbarks, charcoal production, and Nipa palm crafting), which have been estimated using market prices with the following formulas:

Table 4. Direct-Used Value (DUV) Calculations (Source: Bann, 1998: Pearce & Moran,1994: UNEP 2007)

DUV	***Formula***
(1) Fish and Seaweeds value (FV and SV)	(FV; SV) = Production (kg/year) x Price (USD/kg) – Production cost (USD)
(2) Timber value (TV)	(TV) = Timber wood (Bundle/year) x Price (USD/kg) – Production cost (USD)
(3) Charcoal value (CcV)	(CcV) = Production (Sack/year) x Price (USD/kg) – Production cost (USD)
(4) Nipa Palm Crafts (NpcV)	(NpcV)= Production (Piece/year) x Price (USD/piece) – Production cost (USD)
(5) Tanbarks Value (TbV)	(TbV) = Production (kg/year) x Price (USD/piece) – Production Cost (USD)

The Indirect Use Value (IUV) of mangroves was derived from benefit values of mangrove services such as coastline protection especially for the Stilt houses of Sama-Bajau and Tausug peoples, seawater intrusion prevention, nursery grounds for marine resources, and carbon sequestration.

These benefit values were estimated using replacement costs and benefit transfer methods. The coastline protection service was estimated by the cost of breakwater construction over a 10-year project lifespan from Mayudin (2012) and Sathirathai & Barbier (2001). The seawater intrusion prevention provision was measured by the cost of the water supply needs of people if the availability of fresh water was reduced due to mangrove loss (Bann, 1998: UNEP, 2007).

The allocation of nursery grounds service was estimated by foregone benefit from fishery according to the Fisheries Statistics of the Philippines of Philippine Statistics Authority (PSA, 2020), which reported an average loss volume of fish catch in Tawi-Tawi of 4,968.41 tons per year during the period 2015 to 2018. The loss ranging from 1,478.4 to 3,336.7 ha of mangrove in the same period is from Hamilton and Casey (2016) where they projected Southeast Asia as a region of concern with mangrove deforestation rates between 3.58% and 8.08% reduced rate per year multiplied by the total mangrove area of Tawi-Tawi Islands. Southeast Asia is a region containing half of the entire global mangrove forest inventory. Lastly, carbon sequestration was estimated by using transferring rates of carbon storage of mangroves (100 to 200 tons C/ha) from Ong (1993). The price of carbon credits at USD 5.5/tCO2 was based on Diaz et al. (2011). Calculation of IUV was conducted using the following formulas:

Table 5. Indirect-Used Value (IUV) Calculations

IUV	*Formula*
(1) *Coastline protection value (CPV)*	CPV = Coastal length (m) x cost of breakwater construction (USD) Coastal length = 152,200 m; the cost of breakwater constructions has been reported to range between 158 USD/m3 (Mayudin, 2012) and 875 USD/m3 (Sathirathai & Barbier, 2001).
(2) *Seawater intrusion prevention value (SwIPV)*	SwIPV = household population x number of water supply (gallon/day) × Price (USD/gallon) ×365 days (Bann, 1998: UNEP, 2007)
(3) *Provision of nursery grounds value (PNGV)*	PNGV =loss volume of fish catches (kg/year) x fish price (USD/kg) / total loss of mangrove area during the period 2015–2018. (1,4782 ha at 3.58 % loss and 3,336.7 ha at 8.08 % loss) (PSA, 2020)
(4) *Carbon sequestration value (CSV)*	CSV = carbon sequestration rate (100 - 200-ton C/ha) x total area of mangrove (11,272 ha) ×price of carbon market (USD 5.5/tonCO2) Ong (1993) and Diaz et al. (2011)

The Option Value (OV) of mangroves was calculated using the benefit transfer value method. The benefit values of medicinal material from mangrove ecosystems were estimated by transferring the available value from Sribianti (2008), who studied East Luwu District, Indonesia with an annual benefit calculated to 157 USD per hectare (Sribianti, 2008). Since the absence of Option Value studies in the Philippines was limiting the calculation, the value present from Southeast Asia was used specifically in studies present in Indonesia. The assumption of the value was due to the idea that Indonesia has the biggest forest area of mangroves in Southeast

Asia. It was assumed that the value is more or less the same value present in the Philippines.

Lastly, to calculate the Non-Used Value (NUV) of biodiversity of mangroves in the Tawi-Tawi Islands, the valuation was estimated using the contingent valuation method technique. This calculates specifically the Bequest Value of Mangroves in Tawi-Tawi. This method is used to ask the community how much value or price given for the mangrove ecosystem remains maintained. While Existence Value was calculated to be not less than 10 % of the direct use value of ecosystem mangroves (Ruitenbeek, 1991).

Calculation of Bequest Value using Contingent Valuation Method

After gathering the inputs from survey questionnaires administered, the tables were prepared for descriptive analysis of the socio-economic information of the respondents concerning their responses for WTP. While computing respondent's WTP, the used estimation of empirical WTP valuation survey responses from maximum WTP figures reported by the respondent were computed by adding and dividing by the sample size to gain the mean WTP of the sample indicated by the formula below.

$$\text{Mean WTP of total sample} = \sum_{i=1}^{n} Ti \Big/ n$$

Where: '*Ti*' is the reported maximum WTP amount by surveyed respondents and 'n' is the sample size.

The socio-economic factors used in the study that determined the willingness-to-pay of respondents for conservation and protection of mangroves were the household respondent's gender, age, educational attainment, household size, and total monthly income. These are a useful tools in establishing an empirical model. The relationship of the willingness-to-pay of households for improved mangrove protection services is denoted as:

WTP = F (x1, x2, x3… x5)

Where:

WTP = willingness-to-pay conservation and protection services of mangroves.

x1 = gender

x2 = age

x3 =educational attainment

x4 = household size

x5 = Average monthly income

The hypotheses tested the relationship of the WTP for conservation and protection of mangroves should it produce a positive relationship with the age and years of education as it is expected to increase the awareness for mangrove conservation and protection. While the number of members in a household would have also a significant effect on the WTP of the respondents. Additionally, the gender of the respondents was tested should it take significant effect on their WTP and if a higher income would increase WTP since this allows individuals to spend more on the environmental protection of mangroves. All of these were important relationships to the WTP of the respondents.

Using Multiple Linear regression, the relationship between determinants (i.e., the income of the respondent, age of respondent, household size, level of education of respondent, gender of the respondent) and WTP of the person for conservation and protection of mangroves were modeled under SPSS IBM statistical software. This popularly used statistical method is effective since it has comparative mathematical simplicity in addition to the analysis of the primary data gathered wherein the effects of the determinants to WTP are measured through the probability value (P-value).

Chapter IV

RESULTS AND DISCUSSIONS

4.1 Socio-Demographic Profiles

The socio-economic results from the administered survey questionnaire to the fifty (50) respondents are summarized in Table 6.

Table 6. Socio-demographic statistical data from 50 respondents.

Variable	Category	Frequency	Percentage
Gender	Male	39	78%
	Female	11	22%
Age (years old)	15-30	23	46%
	31-45	24	48%
	46-60	3	6%
	61-above	0	
Education	Elementary	15	30%
	Secondary	23	46%
	College	12	24%
Income (PhP)	< 10,000	0	
	10,000 - 20,000	33	66%
	>20,000	17	34%
Household Members	1-3 persons	19	38%
	4-6 persons	27	54%
	7-above	4	8%
Willingness-To-Pay (PhP)	1-1000	29	58%
	1001-3000	6	12%
	3001-6000	3	6%
	Not WTP	12	24%

The fifty (50) respondents involved with the survey questionnaire are composed of 39 or 78% males and 11 or 22% females. While relations on the age of the respondents were assigned with the following (4) ranges of category:

1. Group A: Ages 15-30
2. Group B: Ages 31-45
3. Group C: Ages 46-60
4. Group D: Ages 61-above

Group A was composed of 23 respondents composing 46 % of the total respondents while 24 or 48 % of respondents belonged to Group B. Consequently, 6 % of total respondents belonged to Group C while no respondents were belonging to Group D. The respondents are also grouped according to their highest educational attainment. For primary education, 15 or 30% of the respondents are elementary graduates. For secondary education, 23 or 46% of the total sample were able to finish high school, while, for tertiary education, 12 or 24% of the respondents were able to earn their degree in college. The majority of respondents only reached high school education due to constraints of sending their children to college. While most of them are younger, it is evident that education is mostly a major problem in this province. This is due to a lack of opportunities for parents to financially support their children as well as a lack of interest in pursuing higher education. However, the incomes of the respondents were also identified and were grouped into three (3) based on the actual survey conducted:

1. Group A: Below 10,000 pesos
2. Group B: 10,000 – 20,000 pesos
3. Group C: Above 20,000 pesos

Based on the results, it is apparent that most of them are earning in the Group B category with 33 respondents or 66 % of the total respondents. While there were zero (0) respondents belonging to Group A and 17 or 34 % of respondents belonging to Group C class of income. This implies that most of them are in good condition of generating income. These people were purposely selected since they are the ones generating income from mangroves' goods and services. In terms of categorizing the number of household members per respondent, there were assigned three (3) groups from which they can be categorized:

1. Group A: Household members ranging from 1-3 persons
2. Group B: Household members ranging from 4-6 persons
3. Group C: Household members ranging from 7-above

19 respondents were belonging to Group A which is equivalent to 38 % of total respondents. While there were 27 (54%) and 4 (8 %) belonging to Groups B and C, respectively.

4.2 Willingness to Pay (WTP) of the Respondents

This questionnaire measures how much purchasing power the respondents are willing to give up to conserve and preserve the mangrove forests in the province of Tawi-Tawi. Based on the data, there were 12 or 24 % of respondents who are unwilling to pay for mangroves protection services, while 38 (76 %) of total respondents agreed to pay for conservation and protection services. The 38 respondents were categorized on the level of money they can contribute. The amount of the proposed was categorized into three (3) groups namely:

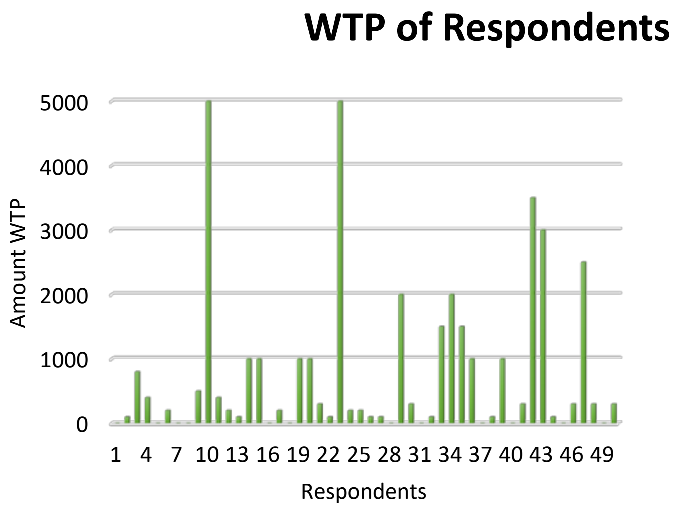
1. Group A: Respondents willing to pay 1-1000 pesos
2. Group B: Respondents willing to pay for 1001-3000 pesos
3. Group C: Respondents willing to pay for 3001-above

Results showed that more than half of the 38 willing-to-pay respondents belonged to Group A category with 29 (58 %) respondents willing to pay as high as 1000 pesos. There were 6 or 12 % of respondents who are willing to pay from 1001 to 3000 pesos belonging to Group B while 3 respondents or 6 % of them belonged to Group C. The willingness to pay of more than half of 38 respondents at 1000 below were coming from the idea that mangroves aren't a priority in their daily lives. Table 7 summarizes the reasons respondents why were not willing to pay for the conservation and preservation of the project for mangrove forestry.

Table 7. Reasons for not willing to pay

Respondents' reasons for not willing to pay	Frequency	Percentage
My family cannot afford to pay	4	33%
I do not believe that the system will bring the changes as described	2	17%
It is the government's responsibility	2	17%
I think that the conservation and protection of mangroves is not important (other works are more important)	2	17%
I believe that the mangroves will be protected and restored without my contribution	1	8%
I do not understand the question	1	8%
Do not know/Not sure	0	0%
Others	0	0%
Total	**12**	**100%**

The computation for WTP given the formula above was computed. The mean WTP was calculated by adding the entire amount designated by the respondents with a total of 37,700 pesos and divided by the number of respondents (38 respondents) willing to pay with 992 pesos per household (Figure 3).



38 out of 50 respondents were willing to contribute amounting to 37,770 pesos. Hence,

$$\frac{37{,}770}{38} = 992 \text{ pesos}$$

Figure 3. Amount WTP of 38 respondents.

This amount of total and mean value will be used as a measure of value for a project to protect and conserve the mangrove forest in the environment also known to be the Bequest value for the total economic value of mangroves in the area. Consequently, how many family units are willing to pay is the economic cost of services for the project to protect the mangrove forests system. The several determinants such as income, educational attainment, age, gender, number of household members are independent factors that influence the results of WTP and can be used by environmental managers for conservation and protection projects.

4.3 Multiple Regression Analyses

The multiple regression analysis was selected to determine the general fitness variance explained/ WTP of the model and the relative contribution of each of the determinants/ predictors to the total WTP variance. The results below summarize the data whether the expectations expressed appear to be true. The data was generated through the use of SPSS IBM statistical software (Table 8).

Table 8. Summary output using multiple regression analysis

Variable	**Unstandardized Coefficients**		**Standardized Coefficients**	**t**	***p***
	B	Std. Error	Beta		
(Constant)	-3524.556	646.896		-5.448	0.000
Gender/Sex	902.802	299.341	0.317	3.016 **	0.004
Age	100.100	219.987	0.051	0.455	0.651
Education	125.672	188.378	0.078	0.667 **	0.508
Income (Pesos)	1343.096	303.282	0.539	4.429**	0.000
Household Size	-217.454	189.663	-0.112	-1.147	0.258

*Note: Constant= -3524.556, F (5,44) = 15.786 ***, p <0.001, R^2 = 0.642*

The overall coefficient of determination (R-Squared) showed 64 % variance of the outcome variable (WTP) can be attributed to the predictor variables (determinants). The observations indicated were the number of respondents (50) included in this analysis. Meanwhile, the slopes for the independent variables or the unstandardized beta coefficients showed a positive slope except the household member variable. This means that the effect of the interaction would imply that the higher the income, the more male respondents, the higher the education, and the younger the age contribute to a greater (more positive) effect of goals on WTP of households.

However, only the Gender and Income variables have significant contributions with *P*-values $P = .004 < 0.05$ and $P = 0.000 < 0.05$, respectively. There was evidence that Gender and Income contributed information in the prediction of WTP.

Although there were unwilling to pay for the project, the high level of WTP exhibited the willingness of the community to contribute money to support the project intended for mangrove forests protection and conservation.

The regression as a whole between Gender, Age, Education, Income, and Household members with the Willingness-to-pay (WTP) predict a significant amount of variance, f (5,44) = 15.786, $P < .001$, $R^2 = 0.642$ is statistically highly significant. A positive coefficient indicates that as the value of the independent variables increase, the mean of the dependent variable also tends to increase the t-test significant level. It indicates very strong evidence against the null hypothesis, as there is less than a 0.01% probability the null is correct.

4.4 Direct-Use Value of Mangroves (DUV)

Since the past decades, people who subsisted in mangrove areas have been highly dependent on the mangroves' goods and services such as numerous fishery and forestry products for domestic and commercial purposes. Benefits from fisheries like fish, seaweeds, and other important coastal and marines' resources, while the forestry-related collection of firewood, charcoal, tanbark production, and nipa palm leaf crafting is generated to produce an income.

In this research, the province of Tawi-Tawi composed of many islands was chosen as the research location. The application of CVM to value the mangrove forest system is an important tool to compute the economic valuation. While some studies do not focus on the impact of climate change as situations in conducting CVM surveys, this CVM study included climate change impacts into its valuation scenarios to investigate if the inclusion of climate change context into the CVM survey could have any influence on the respondents' WTP. Multiple Regression analysis' result confirms this hypothesis as WTP for Bequest Value.

The results of the survey for the market prices of the mangrove products by 50 respondents showed that 14 households are directly using mangroves for fish capture while 9 households were dependent on seaweed income. The fish catches were usually traditional fishing methods using rods for spear fishing while scoops, traps, and nets are for huge catches to be sold at the Bongao Municipality market. The fish capture is done all months of a year; however, the lesser catch is experienced from months January to March because of sea conditions due to strong winds. The seaweed farmers with 9 households are known in Tawi-Tawi to have been a good source of income because of its popular demands. Nevertheless, these farmers are gaining less compared to the middleman when trading this sea product. The middleman buys the seaweed product at a very low price while selling it to the next buyer at a high price. The 5 households have been using mangroves for harvest timber, 11 for charcoal production, 5 for Nipa palm leaf crafting, and 6 for tanbark production. The production averages of fish and sea weed production per year are calculated to be 360,307 kg and 877,813 kg, respectively. The production of timber, charcoal, tanbarks, handcrafts such as roofs, baskets, and especially hats from Nipa palm leaves per year amounted to 18,250 bundles, 25,550 sacks, 182,500 kg, and 36,500 pieces, respectively. All market prices used are based on the first transaction of trading which happens in the local market.

The highest benefit of DUV was obtained from fish production, earning 303,145 USD per year at 27 USD/ha/year, followed by seaweed production for 225,294 USD per year at 20 USD/ha/year. The total net DUV of mangroves in Tawi-Tawi was estimated to be 63 USD/ha/year. Hence, the total benefit of the DUV of the mangrove ecosystem is 708,434 USD per year (Table 9).

Table 9. The Direct Use Value (DUV) of Mangrove in Tawi-Tawi Islands

No.	**Products**	**Household users (n = 50)**	**Net use value (USD/year)**	**Net use value (USD/ha/year)**
			Fishery Products	
1	Fish	14	303,145	27
2	Sea weeds	9	225,294	20
	Sub Total of DUV		**528,439**	47
			Forestry Products	
1	Timber	5	30,059	3
2	Charcoal	11	71,569	6
3	Nipa	5	12,167	1
4	Tanbark	6	66,201	6
	Sub Total of DUV		**179,995**	16
	Total of DUV		**$ 708,434.43**	**$ 63**
			Total Mangrove Area = 11,272 ha	

4.5 Indirect Use Value of Mangroves (IUV)

The indirect use value of the mangrove ecosystem in Tawi-Tawi was obtained using the replacement cost and benefit transfer methods (Table 10). In this case study area, the net benefit values of these mangrove services have been estimated using the replacement cost and benefit transfer methods. The annual values of prevention of coastline erosion provided by mangroves were estimated to be in the range of 2,404,760 USD - 13,317,500 USD or 213 USD/ha - 1,181 USD/ha; while seawater intrusion was 23,968,231 USD or 2,126 USD/ha. The provision of nursery ground service per year was estimated to be 26,885 USD to 11,912 USD or approximately 2 to 1 USD/ha. Additionally, the annual carbon sequestration services were estimated to be in the range of 6,199,600 USD - 12,399,200 USD or 550 USD/ha to 1,100 USD/ha. Thus, annually, the cumulative benefit of IUV mangroves was in the range of 32,599,476 USD - 49,696, 843 USD or 2,892 USD/ha to 4,409 USD/ha.

A few studies have detailed benefit estimations of such mangroves' goods and services, Sathirathai and Barbier (2001) assessed the constructing breakwaters to prevent coastal erosion in Southern Thailand to be 3,679 USD/ha. While Samonte-Tan et al. (2007) evaluated the benefit value of preventing coastline erosion and providing nursery grounds from mangroves in the Bohol Marine Triangle, Philippines to be 672 USD/ha/year and 243 USD/ha/year, respectively. Harahab (2010) calculated the yearly benefit of preventing seawater intrusion in Probolinggo locale, East Java to be at USD 7,000 USD/ha/year. Likewise, Salem and Mercer (2012) detailed the economic estimation of mangroves for coastal protection and carbon sequestration services which are 10.45 to 8,044 USD/ha/year and 39.89 to 4265 USD/ha/year, respectively.

Table 10. The Indirect Use Value (IUV) of Mangrove in Tawi-Tawi Islands

No.	**Products**	**Net use value (USD/year)**	**Net use value (USD/ha/year)**
1	Coastline Protection	2,404,760 - 13,317,500	213 - 1,181
2	Seawater Intrusion Prevention	23,968,231	2,126
3	Provision of Nursery ground	26,885 - 11,912	2 - 1
4	Carbon Sequestration	6,199,600 - 12,399,200	550 - 1,100
	Total of IUV	**$ 32,599,476 - USD 49,696, 843**	**$ 2,892 - USD 4,409**
	Total Mangrove Area = 11,272 ha		

4.6 Option Value of Mangroves (OV)

By transferring benefit values of medicine material of mangroves in East Luwu district Indonesia studied by Sribianti (2008), the estimation of the annual benefit value of medicinal material in the area mangrove extent to 11,272 ha in Tawi-Tawi at 157 USD/ha was 1,769,704 USD/year (Table 11). In the past decades where mangroves have degraded leading to depletion of their composition and diversity. Nonetheless, the economic value of medicinal material in this area is quite high and many species commonly used for medicine are available, such as *Avicennia* sp., *Bruguiera* sp., *Ceriops* sp., *Excoecaria* sp., *Sonneratia* sp., and especially *Rhizophora* sp. (Malik, Fensholt, & Mertz, 2015).

Table 11. The Option Value (OV) of Mangrove in Tawi-Tawi Islands

No.	Products	Net use value (USD/year)	Net use value (USD/ha/year)
1	**Medicine**	**$ 1,769,704**	**157**
	Total Mangrove Area = 11,272 ha		

4.7 Non-Use Value of Mangroves (NUV)

The value of bequest value of the mangrove ecosystem in Tawi-Tawi was estimated using the contingent valuation method technique. This method was used to ask the community how much value or price given for mangrove ecosystem remains maintained. From the calculation results can be seen that the bequest value for people who are around the area have an average value of Willingness to Pay (WTP) of 992 Php/household or 19.84 USD/household with a total of 1,107,397 USD/household or 98 USD/ha/household.

The existence value was simply calculated of about 10 percent of the total Direct-Used Value (DUV) according to Ruitenbeek (1991) have a value of 70, 843 USD/year or 6 USD/ha/year (Table 12).

Table 12. The Non-Use Value (NUV) of Mangrove in Tawi-Tawi Islands

No.	Products	Net use value (USD/household)	Net use value (USD/ha/household)
1	**Bequest Value**	**$ 1,107,397.94**	**98**
	Average Value of WTP	**992 PHP = 19.84 USD**	
		Net use value (USD/year)	**Net use value (USD/ha/year)**
2	**Existence Value**	**$ 70,843.44**	**6**
	10 % of total DUV		
	Total Mangrove Area = 11,272 ha		
	1 USD = 50 PHP		
	No. Households in Tawi-Tawi =	*55,816*	

4.8 Total Economic Value of Mangroves in the Province Tawi-Tawi Islands (TEV)

Based on the sum values of the DUV, IUV, OV, and NUV, the annual benefit of the TEV of mangroves varies between 36,255,856 USD/year to 53,353,223 USD/year or 3,216 USD/ha/year to 4,733 USD/ha/year (Table 13). The largest benefit value of mangroves at around 89 % was derived from the Indirect Use Value (IUV) which consists of the value of coastline protection, seawater intrusion prevention, nursery ground provision, and carbon sequestration. The value of sea water intrusion services dominated the TEV of mangroves in the current study. This finding was similar to many studies of TEV of mangroves especially to the observations from Thailand as reported by Barbier *et al.* (2008) where IUV is the highest valued service the mangrove forest could offer.

Table 13. The Total Economic Value (TEV) of Mangrove in Tawi-Tawi Islands

	Products	Net use value (USD/year)	Net use value (USD/ha/year)	%
1	Direct-Used Value	708,434	63	1.95
2	Indirect-Used Value	32,599,476 - 49,696, 843	2,892 - 4,409	89.92
3	Option Value	1,769,704	157	4.88
4	Non-Used Value	1,178,241	105	3.25
	TEV	**$ 36,255,856 - $ 53,353, 223**	**$ 3,216 - $ 4,733**	**100**

These results suggest the ecological functioning of mangroves has an important role in supporting local people's livelihoods. Currently, there is a lack of awareness in local communities concerning the value of such benefits. People are driven by urgent needs, quick and real benefits that can be easily obtained by exploiting mangroves; they may tend to disregard the sustainability and the greater benefit value provided by this resource. In addition, the lower values of the DUV and OV as compared to the IUV suggest that the mangroves have been degraded and have decreased, thereby impacting fishery and forestry production.

These results propose that the ecological functions of mangroves have a significant part in supporting local people's livelihoods. Presently, there is an absence of mindfulness in the communities especially in Tawi-Tawi province concerning the value of mangroves and their benefits. People are only driven by the idea of maladaptive behavior in using mangroves without realizing the real benefits of the vulnerable forest system. The exploitation of mangroves and disregard of their other important benefit threatens the sustainability and livelihood of the people living near the area. Moreover, the lower values of the DUV, OV, and NUV when contrasted with the IUV suggest that the mangroves have been degraded and have reduced, in this way affecting fishery and forestry production.

Chapter V

SUMMARY, CONCLUSION, AND RECOMMENDATION

The mangroves ecosystem provides direct use value which is utilized by the fisherman, seaweed farmers, and other marine resources with value. This study has demonstrated the economic benefit value of mangrove forests in the province of Tawi-Tawi Islands. The highest contribution of the TEV (Total Economic Value) of mangroves was found to have derived from the IUV (Indirect Use Value) of mangroves. Indirect use value (IUV) is the function of mangroves as protecting the coastline, preventing seawater intrusion, as a nursery ground, and for carbon sequestration.

Direct Use Value (DUV) was coming from the benefit value of fisheries and forestry products while Option Value (OV) was taken from the benefit value of medicine produced by mangroves. Both are at a first glance seems to be financially viable.

Non-use Value (NUV), specifically Bequest Value was obtained from mangrove forest area using willingness to pay (WTP) with an average amount of value 992 PHP or 19.84 USD under contingent valuation. However, this assessment of people's willingness to pay for mangrove projects to conserve and protect depends on the socio-cultural as well as the socio-economic condition of a community near the mangrove area. The higher the awareness of the people, the more it becomes highly recognized as a massive source of ecosystem goods and services. This assessment may not be enough to influence larger-scale issues such as politics, culture, and governance, since respondents did not represent an acceptable sample size of respondents. Nevertheless, it is important to identify the important future services apart from those currently used by society for the future generation's well-being.

Existence Value was estimated to be not less than 10 % of the direct use value. Total Economic Value that exists in the mangrove ecosystem in the province of Tawi-Tawi Islands, Philippines ranges between 36,255,856 USD/year to 53,353,223 USD/year or USD 3,216 to USD 4,733.

Therefore, in this study, mangrove valuation can be used to set monetary values on mangrove forests including all of the environmental costs related to future development to provide a balance economic and environmental compensation. The economic valuation of mangroves is essential in policy making targeting sustainable management of mangroves.

Mangroves can make a significant contribution not only to the local livelihoods but also to the protection services, seawater intrusion prevention, fish and other marine resources' nursery, atmospheric carbon sequestration, and mitigation of climate change impacts. The government, especially the provincial and Bangsamoro Autonomous Region in Muslim Mindanao (BARMM) as a whole must increase their policies and awareness regarding the importance of mangroves on the daily lives of Tawi-Tawi populations. Regulations should restrict the conversion of mangrove forests into other utilization purposes to prevent the rapid decline of mangrove forests in the area. Particularly, the timber and tanbark and charcoal production since it is being observed that most of the people here in Tawi-Tawi are not aware of the consequences brought about by overexploitation. The laws and regulations should be enforced with the mechanism necessary to support protection including sufficient equipment and a competent labor force. This is to back them up enabling them to carry out their responsibilities. Likewise, discouraging the conversion of mangrove areas can be appropriated with scheduled taxes and fees to prevent further incursions to mangrove areas for other utilization purposes.

Additionally, a master plan in the province must be carefully considered to promote sustainable projects which can benefit the local people as well as mangrove areas. Local awareness of climate change issues and the importance of mangroves should be enhanced to get the local communities involved more in mangrove conservation and protection. Particularly, local communities should be engaged in mangrove restoration, conservation, and protection activities from the beginning of the project. Specific steps should be taken to ensure that residents of mangrove-area villages benefit from developments that take place in these areas. Those who have more stable incomes and higher educational levels could be targeted since they can work as key community actors for conducting mangrove conservation and protection activities.

Lastly, since this study has economically valued the mangroves under the context of climate change, to decide appropriate sustainable socio-economic development policies for Tawi-Tawi province in the long term, especially related to the protection and conservation policies of the mangroves, further research to explore the broader socio-demographic roles of the mangroves in the area to the local communities are recommended.

REFERENCES

Ahmed, N., & Glaser M. (2016). Coastal aquaculture, mangrove deforestation and blue carbon emissions: Is REDD+ a solution? *Marine Policy, 66*, 58-66. Retrieved from https://doi.org/10.1016/j.marpol.2016.01.011

Bann, C. (1998). T*he Economic Valuation of Mangroves: A Manual for Researchers*. Retrieved from www.eepsea.net/pub/sp/1997_Bann_Mangroves.pdf

Barbier, E. B. (1991). An approach to economic evaluation of tropical wetlands: With examples from Guatemala and Nicaragua. In Caribbean Ecology and Economics; Girvan, N.P., Simons, D., Eds.; *Caribbean Conservation Association* (pp. 207–231): St. Michael, Barbados.

Barbier, E. B., Acreman, M., & Knowler, D. (1997). *Economic Valuation of Wetlands: A Guide for Policy Makers and Planners*; Ramsar Convention Bureau: Gland, Switzerland.

Barbier, E. B. (2000). Valuing the environment as input: Review of applications to mangrove-fisherylinkages. *Ecol. Econ.*, *35*, 47–61. DOI: DOI: 10.1016/S0921-8009(00)00167-1

Barbier, E. B., & Cox, M. (2003). Does economic development lead to mangrove loss? A cross-country analysis. *Contemporary Economic Policy, 21*(4), 418-432. DOI:10.1093/cep/byg022

Barbier, E. (2007). Valuing ecosystem services as productive inputs*. Econ. Policy*, *22*, 177–230. DOI:10.1111/j.1468-0327.2007. 00174.x

Barbier, E. B., Koch, E.W., Silliman, B. R., Hacker, S. D., Wolanski, E., Primavera, J., Granek, E.F., Polasky, S., Aswani, S., Cramer, L. A.,…Reed, D.j. (2008). Coastal Ecosystem-Based Management with Nonlinear Ecological Functions and Values. *Science*, *319*, 321–323. doi: 10.1126/science.1150349

Barton D N. (1994). *Economic Factors and Valuation of Tropical Coastal Resources (*p 128). Norway: University of Bergen.

Becira, E.M. (2006). State of mangroves in Tiniguiban Cove, Puerto Princesa Bay, Puerto Princesa City, Palawan. *Science Diliman. 2* (17): 46−51. Retrieved from http://journals.upd.edu.ph/index.php/sciencediliman

Brander, L., Florax, R. & Vermaat, J. (2006). The empirics of wetland valuation: A comprehensive summary and a meta-analysis of the literature*. Environ. Resource Econ.*, *33*, 223–250. DOI: https://doi.org/10.1007/s10640-005-3104-4

Brouwer, R. (2000). Environmental value transfer: State of the art and future prospects*.* *Ecol. Econ.*, *32*, 137–152. DOI: https://doi.org/10.1016/S0921-8009 (99)00070-1

Diaz, D., Hamilton, K., & Johnson, E. (2011). *Forest Carbon Market 2011: From Canopy to Currency*; Forest Trend Ecosystem Marketplace (p. 93). Washington, DC, USA, 2011.

Debroy, P., & Jayaraman, R. (2012). Economic valuation of mangroves for assessing the livelihood of fisherfolk: a case study in India. Retrieved from https://core.ac.uk/download/pdf/10195181.pdf

Dumilag, R. V. (2019, November 9). Edible seaweeds sold in the local public markets in Tawi-Tawi, Philippines. Philippine Journal of Science, 148 (4), 795-803. Retrieved from https://www.researchgate.net/publication/337146893_Edible_seaweeds_sold_in_the_local_public_markets_in_Tawi-Tawi_Philippines

FAO. (2007). The world's mangroves 1980–2005. FAO, Rome. Retrieved from http://www.fao.org/3/a1427e/a1427e00.htm

Ferrer, A., Hopanda, J., Orquejo, M., Moscoso, A. & Sadaba, R. (2011). Reversion of disused fishpond lease agreement areas to mangrove forest in Region VI, Philippines. Economy and Environment Program for Southeast Asia (EEPSEA), Los Baños, Laguna, Philippines.

Freeman, A. M. (2003). *The Measurement of Environmental & Resource Values: Theory and Methods*, 2nd ed.; Resources for the Future Press: Washington, DC, USA.

GP. (2021). Geoportal.gov.ph. https://www.geoportal.gov.ph/

Hamilton, S. E., & Friess, D. A. (2018). Global carbon stocks and potential emissions due to mangrove deforestation from 2000 to 2012. *Nature Climate Change*, *8*(3), 240-244. DOI: 10.1038/s41558-018-0090-4

Hoomans, T., & Severens, J.L. (2014). Economic evaluation of implementation strategies in health care. I*mplementation Science, 9,* 168. Retrieved from https://doi.org/10.1186/s13012-014-0168-y

Huxham. M., Emerton, L., Kairo, J.G., & Munyi, F. (2015). Applying Climate Compatible Development and Economic Valuation to Coastal Management: A Case Study of Kenya's Mangrove Forests. Journal of Environmental Management, 157,168-181. DOI: 10.1016/j.jenvman.2015.04.018

Ilka I. C., Friess, D. A., Krauss, K. W., & Lewis, R. R., III. (2017). The state of the world's mangroves in the 21st century under climate change.*Hydrobiologia, 803*(1), 1-12. DOI: 10.1007/s10750-017-3331-z

Hamilton, S.E. & Casey, C. (2016). Creation of a high spatio-temporal resolution global database of continuous mangrove forest cover for the 21st century. *Glob. Ecol. Biogeogr., 25*,729-738. DOI: DOI: 10.1111/geb.12449

Harahab, N. (2010). *Penilaian Ekonomi Ekosistem Hutan Mangrove dan Aplikasinya dalam Perencanaan Wilayah Pesisir*; Graha Ilmu. Yogyakarta, Indonesia.

Long, J., & Giri, C. (2011). Mapping the Philippines' mangrove forests using Landsat imagery.*Sensors (Basel)*. *11* (3), 2972−2981. DOI: 10.3390/s110302972

Malik, A., Fensholt, R., & Mertz, O. (2015). Mangrove exploitation effects on biodiversity and ecosystem services. *Biodiversity & Conservation, 24*(14), 3543-3557. DOI: 10.1007/s10531-015-1015-4

Malik, A., Fensholt, R., & Mertz, O. (2015). Economic Valuation of Mangroves for Comparison with Commercial Aquaculture in South Sulawesi, Indonesia. *Forests, 6, 3028-3044. DOI: 10.3390/f6093028*

Mayudin, A. (2012). Kondisi Ekonomi Pasca Konversi Hutan Mangrove menjadi Lahan Tambak di Kabupaten Pangkajene Kepulauan Propinsi Sulawesi Selatan. *Eksos, 8*, 90–104. Retrieved from http://riset.polnep.ac.id/bo/upload/penelitian/penerbitan_jurnal/05-eksos%203%20-%20arif.pdf

Mendoza, A.B., & Alura, D.P. (2001). Mangrove structure on the eastern coast of Samar Island, Philippines. In D.E. Scott, R.H. Mohtar, and G.C. Steinhardt, eds., Sustaining the global farm? Selected papers from the 10th International Soil Conservation Organization Meeting, May 24–29, 1999, West Lafayette, 423–425. International Soil Conservation Organization, United States Department of Agriculture, Agricultural Research Service, National Soil Erosion Research Laboratory, and Purdue University, West Lafayette.

Mendoza-Viray, V. (2017). *Mangrove Forests in the Philippines*. Retrieved from https://maritimereview.ph/2017/11/22/mangrove-forests-in-the-philippines/

Muallila, R. N., Tambihasan, A.M., Enojario, M.J., Ong, Y.N. & Nañola Jr., C.L. (2020). Inventory of commercially important coral reef fishes in Tawi-Tawi Islands, Southern Philippines: The Heart of the Coral Triangle. Fisheries Research, 230, 105640. https://doi.org/10.1016/j.fishres.2020.105640

Ong, J. E. (1993). Mangroves—a carbon source or sink. *Chemosphere*, *27*, 1097–1107. DOI: https://doi.org/10.1016/0045-6535 (93)90070-L

Onrizal, K. C. (2008). Ecological study on mangrove forest in East Coast of North Sumatra. Biodiversity, 9(1), 25–29. DOI: 10.13057/biodiversity/d090107

Patton, M. (1990). Qualitative evaluation and research methods (pp. 169-186). Beverly Hills, CA: Sage.

Pearce, D. (1992). Green Economics. *Environmental Values, 1*(1), 3-13. Retrieved from http://www.environmentandsociety.org/node/5454

Pearce, D. & Moran, D. (1994). *The Economic Value of Biodiversity*; Earthscan: London, UK.

Perdana, T. A. *et al.* *(*2018). Economic valuation of mangrove ecosystem: empirical studies in Timbulsloko Village, Sayung, Demak, Indonesia, *IOP Conf. Ser.: Earth Environ. Sci.,* 139. Retrieved from https://iopscience.iop.org/article/10.1088/1755-1315/139/1/012035

Primavera, J.H. (2000). Development and conservation of Philippine mangroves: institutional issues. *Ecological Economics.* *35*, 91−106. Doi: http://dx.doi.org/10.1016/S0921-8009(00)00170-1

Primavera, J. H., Sadaba, R. B., Lebata, M. J. H. L., & Altamirano, J. P. (2004). Handbook of mangroves in the Philippines - Panay. Tigbauan, Iloilo, Philippines: Aquaculture Department, Southeast Asian Fisheries Development Center.

Primavera, J.H., Savaris, J. D., Bajoyo, B., Coching, J. D., Curnick, D. J., Golbeque, R., Guzman, A.T., Henderin, J. Q., Joven, R.V., Loma, R.A. & Koldewey, H. J. (2012). Manual for community−based mangrove rehabilitation – mangrove manual series No. 1. Zoological Society of London: London, UK.

Primavera, J.H. (1995). Mangroves and brackish water pond culture in the Philippines. *Hydrobiologia, 295*, 303−309. DOI: https://doi.org/10.1007/BF00029137

PSA (2020, April 9). Fisheries Statistics of the Philippines 2016 – 2018. Retrieved from https://psa.gov.ph/sites/default/files/Fisheries%20Statistics%20of%20the%20Philippines%2C%202016-2018.pdf

Ruitenbeek H J. (1991). *Mangrove Management: An Economic Analysis of Management Options with A Focus on Bintuni Bay, Irian Jaya.* Canada: Dalhousie University Printing Center.

Salem, M. E. & Mercer, D. E. (2012). The Economic Value of Mangroves: A Meta-Analysis. *Sustainability, 4*, 359-383. *DOI:* 10.3390/su4030359

Sandilyan, S. & Kathiresan, K. (2012). Mangrove conservation: a global perspective. *Biodiversity & Conservation, 21*(14), 3523-3542. DOI: 10.1007/s10531-012-0388-x

Samonte-Tan, G. P. B., White, A. T., Tercero, M. A., Diviva, J., Tabara, E., & Caballes, C. (2007). Economic Valuation of Coastal and Marine Resources: Bohol Marine Triangle, Philippines. *Coastal Management*, *35*, 319–338. DOI: https://doi.org/10.1080/08920750601169634

Sathirathai, S., & Barbier, E. B. (2001). Valuing Mangrove Conservation in Southern Thailand. *Contemp. Econ. Policy*, *19*, 109–122. DOI: https://doi.org/10.1111/j.1465-7287.2001.tb00054.x

Spalding, M.D., Ruffo, S., & Meliane, I. (2014). The role of ecosystems in coastal protection: Adapting to climate change and coastal hazards. *Ocean & Coastal Management, 90*, 50-57. DOI: 10.1016/j.ocecoaman.2013.09.007

Sribianti, I. (2008). Valuasi Ekonomi Hutan Mangrove: Studi Kasus Valuasi Ekonomi Kawasan Hutan Mangrove Malili Kabupaten Luwu Timur. J. *Sains. & Teknol.,* 8, 186–192. Retrieved from https://orcid.org/0000-0001-8160-3695

TawiTawiIsland. (2019, September 25). Retrieved from https://en.wikipedia.org/wiki/Tawi-Tawi_Island

UNEP. (2007). *Guidelines for Conducting Economic Valuation of Coastal Ecosystem Goods and Services*; UNEP/GEF/SCS Technical Publication: Bangkok, Thailand.

Tran, T., Nguyen, V. T., Huynh, T. L. H., Mai, V. K., Nguyen, X. H. & H. P. Doan (2016). Climate Change and Sea Level Rise Scenarios for Vietnam. Technical report, Ministry of Natural Resources and Environment of Vietnam.

Waite, R., et al. (2014). *Coastal Capital: Ecosystem Valuation for Decision Making in the Caribbean.*Washington, DC: World Resources Institute. Retrieved from https://www.wri.org/our-work/project/coastal-capital-economic-valuation-coastal-ecosystems-caribbean

Wilson, R., Burke, L., & Lambert, L. J. (2015). *A Situational Analysis of Mangroves in the Mesoamerican Reef System.* Retrieved from http://www.seatoneconsulting.com/wp-content/uploads/2016/03/A-Situational-Analysis-of-Mangroves-in-the-Mesoamerican

Woodward, R. & Wui, Y. (2001). The economic value of wetland services: A meta-analysis. *Ecol. Econ.*, 257–270. DOI: 10.1016/S0921-8009(00)00276-7

APPENDICES

Appendix A

Survey Questionnaire Administered to Fifty (50) Respondents
Identified through Purposive Sampling Method.

I. Household Information

Name of the respondent: ______________________

1. Gender:
   (1) Male
   (2) Female

2. Age: ____

3. Educational Background:
   (1) Primary/elementary graduate;
   (2) Secondary/High school graduate; or
   (3) Tertiary/college graduate

4. Average Income:
   (1) Below 10000 per month;
   (2) 10000 to 20000 per month; or
   (3) 20000 and above per month

5. Number of Household members: __________________

II. Market Price Value of DUV

1. What is your income generating livelihood? (Used for DUV income computation) ________________
2. How much is your known price for fish (Any species of fish) on the average local market price per kilogram? _______________
3. How much is the average local market price for the seaweed (agar-agar) per Kilogram? ______________
4. How much is the average local market price for mangrove timber (kahoy Bakaw) per bundle? _______________
5. How much is the local average price of Charcoal (Buling) per sack? _________________
6. How much is the average price of Nipa products especially Nipa leaf crafting per piece? ______________

7. How much is the average local market price for Tanbarks (Bola) per kilogram? ____________

III. Willingness to pay for propose project to conserve and protect the Mangrove Forest area

The other greatest risk is the impact of climate change and rising sea levels. According to the Intergovernmental Panel on Climate Change (IPCC), the Philippines ranks fourth in the Global Climate Risk Index. Fifteen of the 16 regions of the Philippines are vulnerable to sea level rise. The projected potential sea-level rise means parts of the province's islands could be submerged at high tide, if no protective measures are taken. The area will be affected by the year 2030. The flooded area has an effect on mangrove forest and will likely to cause damage of livelihood especially fishing and seaweed production.

(*Pictures of flooding and destruction of mangroves are shown to visualize the cause and effect of sea level rise contributed by the loss of mangrove forests.)*

These hazards can cause disasters involving damage to property, facilities and infrastructure, hardship for communities and households, and loss of life. The welfare of Tawi-Tawi people would also be impacted through changes in supply and demand for water, food, energy, and other tangible goods that are derived from these systems; changes in opportunities for non-consumptive uses of the environment for recreation and tourism; changes in non-use values of the environment such as cultural and preservation values; changes in incomes; and changes and loss of property and lives from these extreme disasters.

The creation of proposed project to protect the mangrove areas and consequently, prevent the rising of sea level. The project aims to prevent the expansion of urban development into vulnerable low-lying coastal sites around the many islands of Tawi-Tawi by protecting the mangroves in the area. The project will strengthen urban food security, raising awareness of the local community and administrators about the importance of mangroves and contributing to ecologically sustainable and climate-resilient urban development in your area.

If you will be able to contribute for a project protecting and conserving the mangrove forests in your area for the sake of the future and livelihood, would you be willing to pay for such services to realize that project?

If yes, how much are you willing to pay? ____________

If no, then provide your reason why.

Appendix B

Total Economic Value Computations

Table A. Fish and Seaweed production of Tawi-Tawi from Fisheries Statistics of the Philippines of Philippine Statistics Authority (PSA, 2020).

Fish Production Value of Tawi-Tawi Province					
Year	Volume (Kg)	Average Price/ kg	Final Price (PHP)	Final Price (USD)	Production Cost (USD)
2014	343,555.90	50	17,177,795.00	336,819.51	50,098.04
2015	349,259.65	50	17,462,982.50	342,411.42	50,098.04
2016	344,291.24	50	17,214,562.00	337,540.43	50,098.04
2017	368,243.59	50	18,412,179.50	361,023.13	50,098.04
2018	396,188.43	50	19,809,421.50	388,420.03	50,098.04
Average	**360,307.76**	**50.00**	**18,015,388.10**	**353,242.90**	**50,098.04**

Seaweeds Value of Tawi-Tawi Province					
Year	Volume (Kg)	Average Price/ kg	Final Price (PHP)	Final Price (USD)	Production Cost (USD)
2014			-	-	
2015			-	-	
2016			-	-	
2017	899,474.30	40	35,978,972.00	705,470.04	50,098.04
2018	856,152.90	40	34,246,116.00	671,492.47	50,098.04
Average	**877,813.60**	**40.00**	**14,045,017.60**	**275,392.50**	**50,098.04**

- Fish and Seaweeds value (FV and SV)

(FV; SV) = Production (kg/year) x Price (USD/kg) – Production cost (USD)

FV + SV =	**528,439.33**

Table B. Timber production of Tawi-Tawi

Timber Value of Tawi-Tawi Province					
Year	Volume (Bundle/year)	Average Price/ kg	Final Price (PHP)	Final Price (USD)	Production Cost (USD)
2020	18,250.00	100	1,825,000.00	35,784.31	5,725.49
Average	**18,250.00**	**100.00**	**1,825,000.00**	**35,784.31**	**5,725.49**

- Timber value (TV)

(TV) = Timber wood (Bundle/year) x Price (USD/kg) – Production cost (USD)

TV =	**30,058.82**

Table C. Charcoal production of Tawi-Tawi

Charcoal Value of Tawi-Tawi Province					
Year	Volume (Sack/year)	Average Price/ kg	Final Price (PHP)	Final Price (USD)	Production Cost (USD)
2020	25,550.00	200	5,110,000.00	100,196.08	28,627.45
Average	**25,550.00**	**200.00**	**5,110,000.00**	**100,196.08**	**28,627.45**

- Charcoal value (CcV)

(CcV) = Production (Sack/year) x Price (USD/kg) – Production cost (USD)

CcV =	71,568.63

Table D. Nipa leaf crafting production of Tawi-Tawi

Nipa Crafts Value of Tawi-Tawi Province					
Year	Volume (Piece/year)	Average Price/ Piece	Final Price (PHP)	Final Price (USD)	Production Cost (USD)
2020	36,500.00	20	730,000.00	14,313.73	2,147.06
Average	**36,500.00**	**20.00**	**730,000.00**	**14,313.73**	**2,147.06**

- Nipa Palm Crafts (NpcV)

(NpcV)= Production (Piece/year) x Price (USD/piece) – Production cost (USD)

NpcV =	12,166.67

Table E. Tanbarks production of Tawi-Tawi

Nipa Crafts Value of Tawi-Tawi Province					
Year	Volume (Kg/year)	Average Price/ kg	Final Price (PHP)	Final Price (USD)	Production Cost (USD)
2020	182,500.00	20	3,650,000.00	71,568.63	5,367.65
Average	**182,500.00**	**20.00**	**3,650,000.00**	**71,568.63**	**5,367.65**

- Tanbarks Value (TbV)

(TbV) = Production (kg/year) x Price (USD/piece) – Production Cost (USD)

TbV =	66,200.98

Table F. Coastal Protection Calculation of Tawi-Tawi

Coastal Protection Value of Tawi-Tawi Province					
Price	Coastal Length (M)	Cost of Breakwater Construction	Final Price (USD)	Use Value/ year	Use Value/ha/year
at 158 USD	152,200.00	158	24,047,600	2,404,760	213
at 875 USD	152,200.00	875	133,175,000	13,317,500	1,181
Average	**152,200.00**	**516.50**	**78,611,300**	**7,861,130**	**697**

- Coastline protection value (CPV)

CPV = Coastal length (m) x cost of breakwater construction (USD)

Coastal length = 152,200 m; the cost of breakwater constructions has been reported
to range between 158 USD/m3 (Mayudin, 2012) and 875 USD/m3 (Sathirathai & Barbier, 2001).

Table G. Seawater intrusion prevention value of Tawi-Tawi

Seawater intrusion prevention value of Tawi-Tawi Province						
	Household population	Number of water supply (gallon/day)	Price (USD/gallon	Year (365) days	Final Price (USD)	Use Value USD/ha/year
	55,816	10	0.12	365	23,968,231	2,126
Average	**55,816**	**10.00**	**0.12**	**365**	**23,968,231**	**2,126**

- Seawater intrusion prevention value (SwIPV)

SwIPV = household population x number of water supply (gallon/day) × Price (USD/gallon) ×365 days

Table H. Provision of nursery grounds value of Tawi-Tawi

Provision of nursery grounds value of Tawi-Tawi Province					
Loss Area	Loss volume of fish catch (Tons/year) (PSA, 2020)	Fish price (USD/kg)	Total Loss of Mangrove Area (2015-2018)	Final Price (USD)/ year	Use Value/ha/year
at 3.58 %	4,968.41	2	1,478	26,885	2
at 8.08 %	4,968.41	2	3,337	11,912	1
Average	**4,968.41**	**2**	**1,478.40**	**26,885.35**	**2**

- Provision of nursery grounds value (PNGV)

PNGV =loss volume of fish catch (kg/year) x fish price (USD/kg)/total loss of (8) mangrove area during the period 2015–2018 (2,407 ha)

Table I. Carbon Sequestration Value of Tawi-Tawi

Carbon Sequestration Value of Tawi-Tawi Province					
Transfering Rate (Ong, 1993)	Carbon sequestration rate	Total Mangrove Area	Price of Carbon Market (Diaz et al., 2011)	Final Price (USD)/ year	Use Value/ha /year
at 100 tonC/ha	100	11,272	5.5	6,199,600	550
at 200 tonC/ha	200	11,272	5.5	12,399,200	1,100
Average	**150.00**	**11,272.00**	**5.50**	**9,299,400.00**	**825**

CSV = carbon sequestration rate (100 - 200 tonC/ha) x total area of mangrove (11,272 ha) ×priceof carbon market (USD 5.5/tonCO2) (Diaz et al., 2011)

Table J. Option and Non-use Value of Tawi-Tawi

The Option Value (OV) of mangroves OV = 157 USD x 11, 272 Ha OV = $ 1,769,704.00 USD
Non-Used Value (NUV) of biodiversity of mangrove in Tawi-Tawi Islands Bequest Value = $ 1,107,397.94 Existence Value = $ 70,843.44

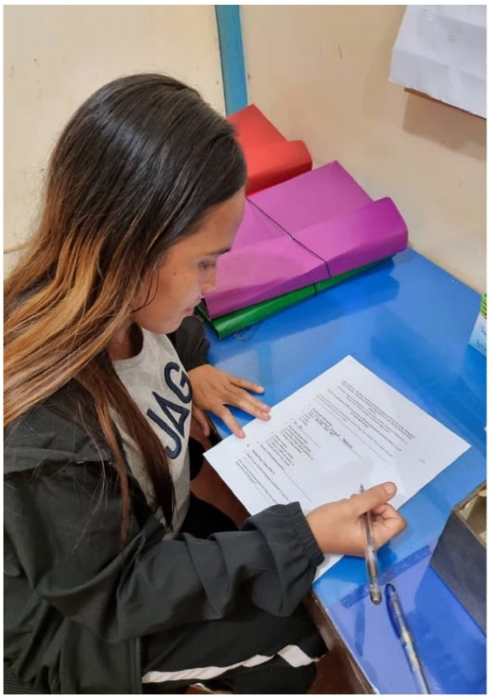
Appendix C

Documentations









JAG


B-LY