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# Estimating the Total Annual Economic Loss Attributed to Climate Variations in Agusan Marsh Wildlife Sanctuary: The Case of Fishing and Farming Activities in Talacogon, Agusan del Sur, Philippines

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A B S T R A C T

The cost of alterations in the quantity or quality of ecosystem services (ES) that are traded on commercial markets can be approximated with the aid of a revealed preference approach, such as the market price method. This study used the market price method to estimate the total annual economic loss from the changes in the demand and supply of fish and crops due to climate variations in Agusan Marsh Wildlife Sanctuary (AMWS). Household interviews were done in the municipality of Talacogon using four sets of structured survey instruments to gather information such as the quantity supplied monthly by fisherfolks and farmers as well as the quantity demanded by residents at different market prices. The consumer surplus and producer surplus during peak and off-seasons were calculated to estimate the annual loss in economic benefits to consumers and producers. The most commonly consumed and produced products in terms of fishing and farming were *Channa striata* and *Oryza sativa* L., respectively. Climate variations have an impact on both fishing and farming commercial activities. During the dry season (March to August), fewer fish are caught due to low water levels in rivers and lakes, while crops cannot be planted during the wet season (September to February) because a lot of land areas are flooded. The total annual economic loss was calculated at PHP 99,974.50. This estimated monetary value can be a basis for decision-makers and concerned stakeholders to efficiently allocate funds for sustainable programs to capacitate the fisherfolks and farmers to increase adaptation mechanisms for climate variations.

Keywords: *Climate variations; market price; total annual economic loss; wetlands*

## 1 Introduction

Ecological systems provide benefits that contribute to the overall well-being of humans. These benefits are widely known as ecosystem services (ES) which are categorized into four broad categories: 1. provisioning services such as the production of food, water, fuel, and wood; 2. regulating services like regulation of water quality, flood, climate, and pest control; 3. cultural services which include education, spiritual, and recreation; and 4. supporting services that are necessary for the production of other ES which encompasses nutrient cycling and photosynthesis, among others

(Millennium Ecosystem Assessment 2005). While some ES already have market prices, others do not have hence cannot be traded directly in commercial markets (Carson and Bergstrom 2003). In the absence of a price tag, market failure often happens, and ecosystems are undeniably exploited. Additionally, property rights regime also plays a pivotal role. Since most of the ES are classified as public goods, non-paying users of a certain ES are difficult to exclude (low excludability), and the consumption of one person cannot prevent simultaneous consumption by another person (low rivalry in consumption) (Quah and Tan 2019) which eventually lead again to overexploitation.

Consequently, environmental degradation can be attributed to market failure or the absence of a market that accounts for externalities from a certain economic activity wherein a given ES is utilized. These externalities are forms of market distortion that cause unintended positive benefits or negative consequences to a third party. When these externalities and problematic property rights regimes are not taken into consideration, there will be a misallocation of scarce resources (Dasgupta 1996). Thus, the assignment of monetary values to ES through valuation is crucial and essential.

Ecosystem valuation focuses on the economic value of change in the quality or quantity of resource stock rather than the true value of ecosystems. In estimating direct consumptive use values like fish and crops, a revealed preference approach such as the market price method is more suitable (Hailu 2013). The market price method estimates the value of the changes in the quality or quantity of ES using the prices of goods that are traded in commercial markets (King and Mazzotta 2000).

Wetlands are among the most productive and valuable ecosystems in the Philippines, given that the average area of their largest type is 126,000 ha (Sespeñe et al. 2016). They serve as important habitats for different wildlife species, including migratory waterfowl. The RAMSAR Convention declared the Agusan Marsh Wildlife Sanctuary (AMWS) as a "Wetlands of International Importance" in 1999 (Sespeñe et al. 2016), and is one of the designated natural wetlands in the country. Aside from its biodiversity importance, AMWS provides food, such as fish and crops, to the dwellers within the protected area. It further acts as a natural flood control and water filtration system for the downstream communities (Mora-Garcia et al. 2020).

Despite these importance, threats and problems such as the conversion of forestland to agricultural production areas, illegal fishing, illegal logging, and wildlife hunting challenged the natural production of ES in the area. Climate variations also aggravate the impacts of these anthropogenic activities (DENR 2015). Thus, this study aimed to estimate the total annual economic loss due to climate variations in AMWS using the market price method, specifically in the case of fishing and farming activities in Talacogon, Agusan del Sur. This helps in designing sustainable programs to compensate for the loss of economic benefits to consumers and producers.

## 2 Materials and Methods

### *Study Area*

The study was conducted from January to May of 2018 in the municipality of Talacogon. The area is part of the geopolitical boundary of Agusan Marsh Wildlife Sanctuary (AMWS), in the province of Agusan del Sur, Caraga Region, the Philippines. The AMWS covered six (6) municipalities, namely: Bunawan, La Paz, Loreto, Rosario, Talacogon, and San Francisco. Talacogon was documented to have the highest number of marsh inhabitants specifically the number of fisherfolks and farmers (DENR 2015). In this study, five (5) villages were chosen considering the route of the river, nearby lakes, creeks, and the number of fisherfolks and farmers. These are the villages of Desamparados, La Flora, Marbon, Sabang Gibong, and San Nicolas (Figure 1).

The common fishing gears used by fisherfolks in the said study areas are fish pots, push nets, cast nets, set gill nets, and set long lines. Electrofishing is common in Sabang Gibong, and La Flora. Push nets and cast nets, on the other hand, are only used in La Flora. The village of La Flora is considered a major landing center with direct fishers, and many of the fisherfolks live in floating houses. Fish ponds are also practiced specifically in Marbon, and fisherfolk associations are noted in Desamparados and San Nicolas. Agriculture is also one of the primary livelihood activities in the area. Rice and corn are the common crops planted in all of the study areas. Explicitly, the soil in Maharlika and La Flora is effective in the substantial production of corn. Irrigation canals

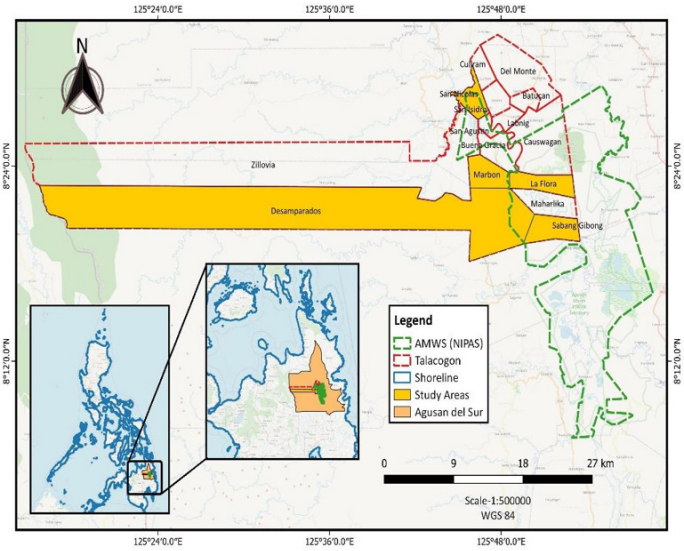


Figure 1. Location map of Agusan Marsh Wildlife Sanctuary with the five villages in Talacogon, Agusan del Sur, Philippines

are commonly used in the fields, and farmers' and irrigators' associations are established (Mindanao State University-Naawan 2013, and Baclayo et al. 2020).

***Household Interviews***

A stratified random sampling technique was used to gather representative samples from Talacogon's total population of 38,374 (Philippine Statistics Authority Census 2015). The population was divided into subgroups or strata (different villages for this case), and samples were randomly selected from the strata. The appropriate sample size was calculated using the formula of Cochran (1963):

$$n_0 = \frac{z^2 \rho q}{e^2} \qquad (1)$$

where $n_0$ is the sample size, $z$ is 1.96 at 95% level of confidence, $\rho$ is the sample proportion (0.50), $q$ is $1-\rho$ and $e$ is the margin of error (0.50);

$$n = \frac{n_0}{1+\frac{(n_0-1)}{N}} \qquad (2)$$

where $n$ is the sample size and $N$ is the population size.

Hence, a total of 603 respondents were interviewed in the five chosen villages of Talacogon consisting of 99 (16%) fisherfolks, 217 (36%) farmers, and 287 (48%) residents (Table 1). The target number of respondents was predetermined, however, there are changes in the actual number of respondents being interviewed. Therefore, the percentages per sector were identified after the conduct of the interview. One-on-one household interviews were done using four sets of structured survey instruments (for fisherfolks, farmers, and residents that consumed numerous species of fish and crops) to gather information such as the quantity of fish and crops supplied monthly by fisherfolks and farmers as well as the quantity demanded by residents at different market prices. Moreover, the survey instruments contain questions about the fishing and farming activities within AMWS, specifically the common fish and crops produced and consumed, types of fishing gear commonly used by the fisherfolks, factors that affect the said commercial activities, and marketing channels or buying schemes. The collected data were analyzed using descriptive statistics.

***Revealed Preference Approach (Market Price Method)***

The market price method by King and Mazzotta (2000) was used to estimate the total annual economic loss from the changes in the demand and supply of fishing and farming activities within Talacogon. Calculating the consumer and producer surplus is important in estimating the total annual economic loss. Consumer surplus

is the amount that individuals would have been willing to pay minus the amount that they actually paid, while producer surplus is the amount that a seller is paid for a good minus the seller's actual cost (Stanlake and Grant 1999). Furthermore, the market equilibrium is the point where the demand and supply intersect. It is important in determining the equilibrium price and quantity (Dean et al. 2016). Figure 2 shows the consumer and producer surplus in a graph. They were calculated using the formula in determining the area of a triangle as shown below (Frakt and Piper 2014):

Area of a triangle (consumer and producer surplus) = ½ (base x height) (3)

Two scenarios were compared in this study — the peak season and the off-season. The before and after closure scenarios are not applicable in the study area since the commercial fishing and farming activities in Talacogon are not limited or bounded to one area. Therefore, the actual values of the changes in the quantity of consumption and production due to climate variations were used. The total annual economic loss was estimated using the seven steps provided by King and Mazzotta (2000) which were also used by Adeyemi et al. (2012). The modified one was used accordingly:

Step 1 - Estimating the market demand function and consumer surplus during the peak season

*Consumer Surplus*

*= (Initial Market Price - Maximum Willingness-to-Pay) × (Annual Demand ÷ 2)*

Step 2 - Estimating the market demand function and consumer surplus during the off-season

*New Consumer Surplus*

*= (Initial Market Price - Maximum Willingness-to-Pay) × ( Annual Demand ÷ 2)*

Step 3 - Estimating the annual loss in economic benefits to consumers

*Consumer surplus during the peak season minus the consumer surplus during the off-season*

Step 4 - Estimating the supply function and producer surplus during the peak season

Table 1. Number of respondents interviewed in Talacogon, Agusan del Sur

| Villages | Fisherfolks (Producers) | Farmers (Producers) | Residents (Consumers) |
|---|---|---|---|
| Desamparados | 17 | 35 | 61 |
| La Flora | 27 | 77 | 51 |
| Marbon | 14 | 41 | 59 |
| Sabang Gibong | 22 | 27 | 53 |
| San Nicolas | 19 | 37 | 63 |
| **Total** | **99** | **217** | **287** |
| **Grand Total** | | **603** | |

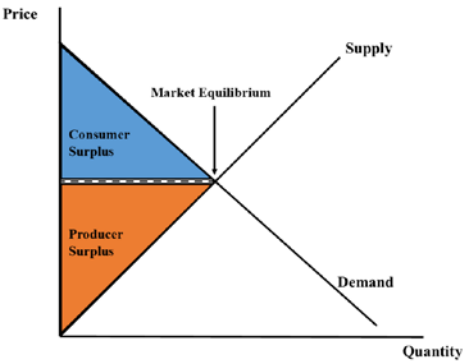


Figure 2. The demand and supply model showing the consumer and producer surplus (Source: Stanlake and Grant 1999)

*Producer surplus*
*= Total revenues earned – Total variable costs of production*

Step 5 - Estimating the supply function and producer surplus during the off-season
*New Producer surplus*
*= Total revenues earned – Total variable costs of production*

Step 6 - Estimating the annual loss in economic benefits to producers
*Producer surplus during the peak season minus the producer surplus during the off-season*

Step 7 - Estimating the total annual economic loss
*Annual loss in economic benefits to consumers + annual loss in economic benefits to producers*

***Ethics statement***

The study was conducted with clearance from the Protected Area Management Board-Department of Environment and Natural Resources (PAMB-DENR) Caraga Region through the approval of the Protected Area Superintendent's (PASu) Office-Agusan Marsh Wildlife Sanctuary (AMWS). Prior informed consent from the barangay captain was also secured and all respondents gave their informed consent before they participated in the study. Their participation was voluntary, which means that they have the liberty to participate or not. Furthermore, all collected data were kept confidential in accordance with the Philippine Data Privacy Act of 2012 (RA 10173). The research team only has access to the information gathered from the field, and the names or identities of the respondents are concealed in the results and discussions of this study.

## 3 Results and Discussion

***Fishing Activities in Talacogon***

The investigation revealed that the fish species commonly caught and sold in Talacogon Market were *Anabas testudineus* (Puyo), *Channa striata* (Halu-an), *Clarias gariepinus* (Taiwan, Hito) *Clarias macrocephalus* (Pantat), *Cyprinus carpio* (Karpa), *Oreochromis niloticus* (Tilapia), and *Osphronemus goramy* (Giant gourami). *Channa striata* is the most commonly consumed and produced in a month with an average volume of 11 kg and 185 kg, respectively (Figure 3). These findings are similar to the study of Baclayo et al. (2020) wherein the said species is the most dominant. Some of them are abundant in population status, like Halu-an, Tilapia and Karpa while some are scarce like the Puyo, Taiwan/Hito, Pantat, and Giant Gourami.

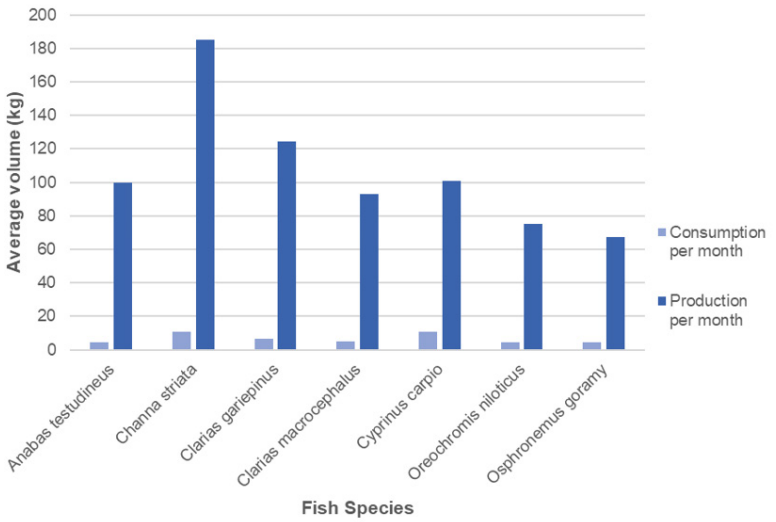


Figure 3. Monthly consumption and production of various fish species in Talacogon, Agusan del Sur

In terms of fishing gears, fisherfolks in the area commonly used the bottom set longline (taga), bottom set gill net (pukot), and fish pot (screen) (Figure 4). They are commonly used during the months of March to May. The taga is a long mono nylon with a large series of baited hooks that are attached at the bottom of the water to prevent it from moving with the current. It is baited naturally with shrimps, gourami, and dead frogs. The pukot is a 100 m long mono nylon with mesh sizes of 5-6 cm. It has a height of 2 m and is also attached to the bottom of the water to prevent it from moving with the current. Rubber floaters are attached to the float line at a distance of 1.5 m and the lead sinkers are tied to the sinker line at a distance of 0.35 m. The screen is a rectangular receptacle made from metal chicken wires with a non-return valve located at the top. This valve provides an easy entrance but difficult to exit. This pot is commonly placed in a grassy substrate for a year by fisherfolks through a non-motorized boat, which aims to catch fish species such as tilapia and karpa (Mindanao State University-Naawan 2013).

One factor that greatly affects fishing is the climate. The months of September to February are the peak season for fishing. However, during the dry season (March to August), fewer fish are caught due to low water levels in rivers and lakes. Illegal fishing, like electric fishing, was also identified and still exists despite the strong regulations prohibiting it. Water pollution and land degradation are also noted (Figure 5). Conversion of many parts of the marshland to rice land, illegal logging operations, contaminants from mining operations, domestic wastes, and agricultural wastes are the causes of these identified factors that affect fish catch (Mindanao State University-Naawan 2013).

With regard to marketing channels or buying schemes, house-to-house selling and commercial markets, including dealers, were observed. Most of the fisherfolks sell their fish through dealers, and every fisherfolk has an average of three dealers. Cash payments were commonly observed, and the usual location of markets is within the municipality or village.

### *Farming Activities in Talacogon*

The common crops planted within the marsh are *Oryza sativa* L. (Rice) and *Zea mays* (Corn). Rice is the most commonly consumed and produced annually, with an average volume of 616 kg and 4,261 kg, respectively (Figure 6). Sweet potatoes, cassava, and peanuts are also planted within the area but are only consumed in households and not sold in commercial markets. The farmers have an average farming lot area of 1 ha and plant crops only once a year because of the rising water level during the months of December to February. Nonetheless, some tried to plant twice a year (Mindanao State University-Naawan 2013).

The months of March to August (dry season) are the peak season for farming, which is done in a large part of the marsh. Most of the local residents are farmers during the dry season and become fishers during the wet season (Mora-Garcia et al. 2020). Similar to fishing, climate variations are one of the factors that affect farming activities since land areas are flooded during the wet season (September to February). Land degradation and financial constraints are also recognized. However, the common problems of farmers are pests like rats, worms, black bugs, snails, weevils, and stem borers (Figure 7). They are the culprits of low yields because they feed on a growing number of

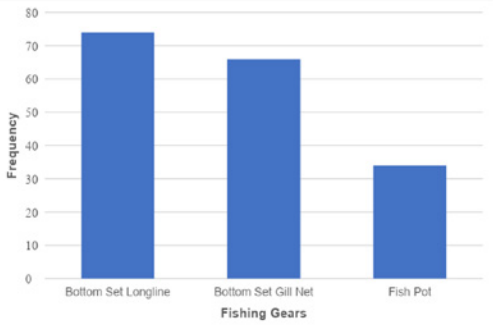


Figure 4. Common fishing gears used by fisherfolks in Talacogon, Agusan del Sur

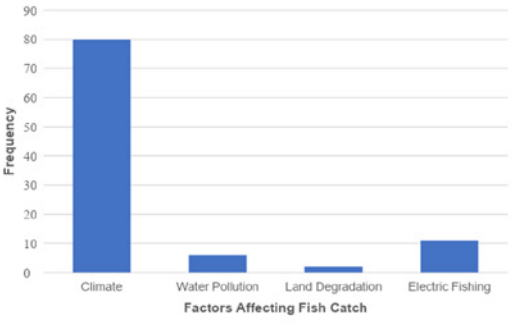


Figure 5. Perceptions of the respondents on the factors that affect fish catch

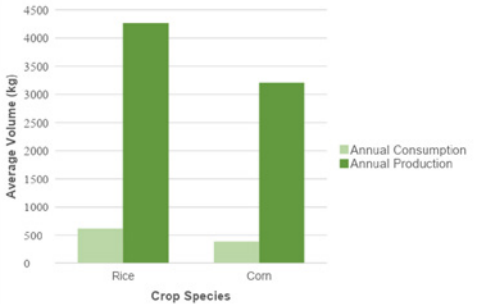


Figure 6. The annual consumption and production of crops in Talacogon, Agusan del Sur

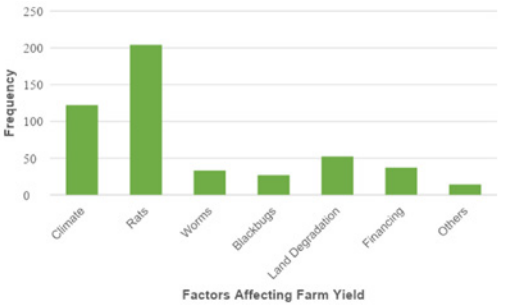


Figure 7. Perceptions of the respondents on the factors that affect farm yield

crops. Climate change increases the risk of pests spreading in agricultural and forestry ecosystems. A warmer climate exacerbates the establishment of invasive pests and helps to change their migratory patterns and geographical distribution (Food and Agriculture Organization 2021). In terms of marketing channels or buying schemes, dealers were highly noticed, and every farmer has an average of one dealer. Most are buyers in commercial markets. Cash payments and direct selling were commonly observed, and the usual location of markets is within the municipality or village.

***Consumer Surplus and Annual Loss in Economic Benefits to Consumers***

Fishing and farming are the main sources of livelihood in Agusan Marsh. These commercial activities produce ecosystem products such as fish and crops. The species of fish and crops shown in Table 2 are commonly consumed by residents and sold in the commercial markets of Talacogon, Agusan del Sur. Following the steps of the market price valuation method, consumer surplus and annual loss in economic benefits to consumers were estimated first. This was done through the identification of the initial market price and maximum willingness-to-pay (WTP) per species of fish and crops during peak and off-seasons. The unit of measurement is in Philippine pesos per kilogram (PHP/kg). The volume of catch per species purchased by consumers annually was also identified (kg). These are averages of the actual values collected in the area. It is evident that the initial market price increases during off-season and the consumers' demand decreases.

It is assumed that the quantity demanded during the off-season would fall to 60% as adapted from the studies of King and Mazzotta (2000) and Adeyemi et al. (2012). The data on the quantity demanded during the off-season was not captured because the respondents still bought the same quantity of fish and crops during the off-season despite the increase in market prices. This shows that the respondents' behavior is price-inelastic. It means that a change in price results in only a small change in quantity demanded (Hofstrand 2020). As pointed by Fibich et al. (2005), the price elasticity of demand is due to various factors which include the availability of substitute products, the importance or necessity of a good in reference to expenditure, time for adjustment, product durability, and range of uses. In this study, the results showed price-inelastic behavior because the said goods are of great necessity to the locals and are commonly consumed daily. The annual loss in economic benefits to consumers ranges from PHP 511 to PHP 1,037. This is crucial in estimating the total annual economic loss due to climate variations.

***Producer Surplus and Annual Loss in Economic Benefits to Producers***

The estimation of producer surplus and annual loss in economic benefits to producers was the next step. The total revenues vary per species since their initial market price and quantity demanded by the consumers also vary. Furthermore, the total variable costs vary per species because the volume sold per species also varies (Table 3). On the part of producers, an increase in price leads to an increase in quantity supplied, and a decrease in price also decrease the quantity supplied (Dean et al. 2016). The average variable costs per kg for fish species,

rice, and corn were calculated at PHP 2.30, PHP 7.43, and PHP 9.23, respectively. These costs were multiplied by the average volume sold per season for each ecosystem product. The resulting values are the total variable costs. The difference between the total revenues and the total variable costs is the producer surplus, while the difference between the producer surplus during peak season and off-season is the annual loss in economic benefits to producers (King and Mazzotta 2000).

### *Total Annual Economic Loss*

The annual loss in economic benefits to consumers and producers as a result of climate variations was added to determine the total annual economic loss for each species of fish and crop. The amount computed was 99,974.50 PHP (Table 4). The approximate monetary worth of this asset can serve as a foundation for directing financial resources towards initiatives that empower farmers and fishermen to enhance their capacity

Table 2. Consumer surplus and annual loss in economic benefits to consumers per ecosystem products

| Ecosystem Products | Initial Market Price during Peak Season (PHP/kg) | Maximum WTP (PHP/kg) | Quantity Demanded by Consumers during Peak Season (kg) | Consumer Surplus during Peak Season (PHP) | Initial Market Price during Off-Season (PHP/kg) | Quantity Demanded by Consumers during Off-Season (kg) | Consumer Surplus during Off-Season (PHP) | Annual Loss in Economic Benefits to Consumers (PHP) |
|---|---|---|---|---|---|---|---|---|
| **Fishing Activities** | | | | | | | | |
| *Anabas testudineus* (Puyo) | 45.00 | 61.00 | 235 | 1,880.00 | 47.00 | 141 | 987.00 | **893.00** |
| *Channa striata* (Halu-an) | 85.00 | 100.00 | 142 | 1,065.00 | 87.00 | 85 | 553.80 | **511.20** |
| *Clarias gariepinus* (Taiwan, Hito) | 79.00 | 96.00 | 244 | 2,074.00 | 81.00 | 146 | 1,098.00 | **976.00** |
| *Clarias macrocephalus* (Pantat) | 81.00 | 98.00 | 112 | 952.00 | 83.00 | 67 | 504.00 | **448.00** |
| *Cyprinus carpio* (Karpa) | 67.00 | 83.00 | 152 | 1,216.00 | 69.00 | 91 | 638.40 | **577.60** |
| *Oreochromis niloticus* (Tilapia) | 79.00 | 95.00 | 133 | 1,064.00 | 80.00 | 80 | 598.50 | **465.50** |
| *Osphronemus goramy* (Giant gourami) | 62.00 | 73.00 | 191 | 1,050.50 | 65.00 | 115 | 458.40 | **592.10** |
| **Farming Activities** | | | | | | | | |
| *Oryza sativa* L. (Rice) | 46.00 | 53.00 | 610 | 2,135.00 | 47.00 | 366 | 1,098.00 | **1,037.00** |
| *Zea mays* (Corn) | 35.00 | 44.00 | 381 | 1,714.50 | 36.00 | 229 | 914.40 | **800.10** |

Table 3. Producer surplus and annual loss in economic benefits to producers per ecosystem products

| Ecosystem Products | Total Revenues during Peak Season (PHP) | Total Variable Costs during Peak Season (PHP) | Producer Surplus during Peak Season (PHP) | Total Revenues during Off-Season (PHP) | Total Variable Costs during Off-Season (PHP) | Producer Surplus during Off-Season (PHP) | Annual Loss in Economic Benefits to Producers (PHP) |
|---|---|---|---|---|---|---|---|
| **Fishing Activities** | | | | | | | |
| *Anabas testudineus* (Puyo) | 15,431.00 | 786.00 | 14,645.00 | 9,860.00 | 1,572.00 | 8,288.00 | **6,357.00** |
| *Channa striata* (Halu-an) | 48,579.00 | 1,788.00 | 46,791.00 | 42,545.00 | 1,910.00 | 40,635.00 | **6,156.00** |
| *Clarias gariepinus* (Taiwan, Hito) | 40,422.00 | 851.00 | 39,571.00 | 19,335.00 | 1,582.00 | 17,753.00 | **21,818.00** |
| *Clarias macrocephalus* (Pantat) | 15,320.00 | 413.00 | 14,907.00 | 14,400.00 | 640.00 | 13,760.00 | **1,147.00** |
| *Cyprinus carpio* (Karpa) | 28,749.00 | 988.00 | 27,761.00 | 18,399.00 | 1,405.00 | 16,994.00 | **10,767.00** |
| *Oreochromis niloticus* (Tilapia) | 24,482.00 | 832.00 | 23,650.00 | 17,250.00 | 1,126.00 | 16,124.00 | **7,526.00** |
| *Osphronemus goramy* (Giant gourami) | 22,875.00 | 779.00 | 22,096.00 | 11,100.00 | 1,363.00 | 9,737.00 | **12,359.00** |
| **Farming Activities** | | | | | | | |
| *Oryza sativa* L. (Rice) | 41,827.00 | 13,864.00 | 27,963.00 | 32,671.00 | 19,143.00 | 13,528.00 | **14,435.00** |
| *Zea mays* (Corn) | 27,333.00 | 12,034.00 | 15,299.00 | 19,947.00 | 17,757.00 | 2,190.00 | **13,109.00** |

Table 4. Total annual economic loss due to climate variations

| Ecosystem Products | Annual Loss in Economic Benefits to Consumers (PHP) | Annual Loss in Economic Benefits to Producers (PHP) | Total Annual Economic Loss (PHP) |
|---|---|---|---|
| **Fishing Activities** | | | |
| *Anabas testudineus* (Puyo) | 893.00 | 6,357.00 | **7,250.00** |
| *Channa striata* (Halu-an) | 511.20 | 6,156.00 | **6,667.20** |
| *Clarias gariepinus* (Taiwan, Hito) | 976.00 | 21,818.00 | **22,794.00** |
| *Clarias macrocephalus* (Pantat) | 448.00 | 1,147.00 | **1,595.00** |
| *Cyprinus carpio* (Karpa) | 577.60 | 10,767.00 | **11,344.60** |
| *Oreochromis niloticus* (Tilapia) | 465.50 | 7,526.00 | **7,991.50** |
| *Osphronemus goramy* (Giant gourami) | 592.10 | 12,359.00 | **12,951.10** |
| **Farming Activities** | | | |
| *Oryza sativa* L. (Rice) | 1,037.00 | 14,435.00 | **15,472.00** |
| *Zea mays* (Corn) | 800.10 | 13,109.00 | **13,909.10** |
| | ***TOTAL*** | | **99,974.50** |

to withstand climate fluctuations. Moreover, their status as land managers qualifies them to advocate for the implementation of sustainable land use practices in AMWS. In addition to economic development investments such as road construction, school buildings, and river dikes, programs may provide non-monetary compensations and monetary compensations in the form of provisions of fishing gear and farming equipment, employment opportunities, and alternative means of subsistence. If a sustainable financing scheme for the ecosystem services management program will be implemented, the estimated amount will be the head start for decision-makers and concerned stakeholders when efficiently allocating scarce resources (Mora-Garcia et al. 2020).

## 4 Conclusion and Recommendations

Fishing and farming are the main sources of livelihood in Talacogon, situated within the geopolitical boundary of Agusan Marsh Wildlife Sanctuary (AMWS). The livelihoods of residents are affected by existing threats in AMWS such as land conversion, illegal fishing, illegal logging, and wildlife hunting. Climate variations aggravate these threats. Thus, estimating the total annual economic loss from the changes in the demand and supply of fish and crops due to climate variations in AMWS is crucial.

The most commonly consumed and produced products in terms of fishing and farming were *Channa striata* and *Oryza sativa* L., respectively. Climate variations have an impact on both commercial activities. During the dry season (March to August), fewer fish are caught due to low water levels in rivers and lakes, while crops cannot be planted during the wet season (September to February) because a lot of land areas are flooded. The total annual economic loss of these ecosystem goods due to climate variations was calculated at PHP 99,974.50. This estimated monetary value can be a basis for decision-makers and concerned stakeholders to efficiently allocate funds for sustainable programs to capacitate the fisherfolks and farmers to increase adaptation mechanisms for climate variations.

The conduct of valuation studies in other areas within the geopolitical boundary of AMWS is recommended because the estimated monetary value is only specific to the municipality of Talacogon. The demand and supply of products might be different in other municipalities. The findings of this study should be used cautiously since we are considering a lot of assumptions. Furthermore, more studies using the market price method should be carried out to improve and develop its usage.

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**Statement of Conflict of Interest**

The authors declare that there is no conflict of interest regarding the publication of this paper.

**Author Contribution Statement**

Roberto G. Campos Jr.: Acquisition of primary and secondary data, data analysis, interpretation, and writing of the manuscript. Meycel C. Amarille: Conceptualization and design of the study, data analysis, interpretation, and revision of manuscript for publication. Romell A. Seronay: Conceptualization and design of the study, and revision of manuscript for publication. Dr. Seronay, as a member of the JESEG Editorial Board, did not participate with the review process. All authors approved the final version of the manuscript.

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