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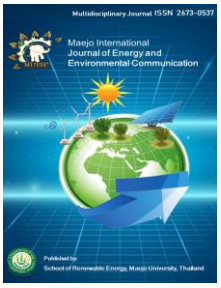

ARTICLE

Factors affecting household's willingness to pay for the fish conservation zones a case study from Khong District, Champasak Province, Laos

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ABSTRACT

This research aims to estimate whether the WTP for fish conservation zones in terms of fish species protection areas. The authors used cross-sectional data that was collected from 369 respondents in 3 target villages in the Khong district of Champasak province Laos in 2021 and utilised WTP and maximum likelihood regression, marginal effect result for analysis. The estimate of the empirical model used for econometric analysis is based on the previously described model. This study finds that the average WTP households in target villages for fish conservation zones is 12.12 US $/household/year. The bid price, the recognition of the necessity of the fish conservation zones' knowledge, and average monthly income all positively impact WTP for fish conservation zones with a statistically significant impact. The authors conclude that the fish conservation zones might increase fish species in the study area. This valuation can be calculated as the cost to improve the quality of establishing fish conservation zones by multiplying the number of people in three villages of 768 households, which is the value expectation of the economy at 9,310 US $/year. However, improving public goods conservation now is the duty of everybody, so if we would like to strengthen fish conservation zones more efficiently than ever, we may find more suitable and sustainable alternatives.

1. Introduction

As we may know, today's world is facing challenges that organizations are interested in and concerned about, especially the changing climate. The world survey of international issues the state of the environment in late 2017 indicates that over 10 years ago, the destruction of natural resources, was the world's most historical human impact on the area of the world where rich 40% of the world's forests have been destroyed. More than 1,000 species have gone extinct, and hundreds of species are endangered, especially fly fish, birds, and mammal's species. Also, the survey also suggests that over time, such as during the average temperature, world records ever recorded in (Bexell and Jönsson, 2017). This

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problem is caused by the rapid growth of the world's population, the socio-economic growth, science and technology, which has led to the exploitation of large amounts of natural resources to meet the insatiable demand for human resources, which has resulted in the depletion of the world's natural resources (Kyem, 2021).

We are a country that has been affected, like many countries in the past. Although government will put the vision of a development-economic society together to protect the environment, the government will continue operating continuously to exploit more types of resources, causing the deterioration of the environment. The Mekong is one example of the importance of the rich who are affected. It's like blood vessels sapping people over 60 million in the Mekong. The river's source of fisheries in the second world creates a stable of food for rural areas along the Mekong (Molloy et al., 2003). And provide more than half of the local people's animal protein, with an annual income of 1,000 to 1.8 million tons of fish worth $1.4 billion (Baran et al., 2007). Also, several species that live in the river are affected by the increase in the population, the growth of the growing economy, logging, deforestation, mining resources, minerals released contaminants into rivers and activities of humans stemming from dams, energy, water, construction right across the river, fishing, fishermen, and others (Ramírez et al., 2008).

Figure 1 Illustrate Khong District, Champasak Province, Southern Laos.

A survey by the Aguinot, (2014). investigated that many endangered species of aquatic animals are now endangered, such as the Mekong Delta dolphin, or (Orcaella brevirostris), giant catfish, turtles, tigerfish, and more. It creates serious anxiety, which has more government units that must solve this problem. One of the options crucial which will be able to bring the practice action is to establish conservation zones management and regular maintenance of fish and other aquatic life. This enables the mother to reproduce and expand to other areas, which will enable people to catch the fish more efficiently and sustainably. From 2012 to 2015, the government set out to create 30 fish conservation zones in 30 villages and expand them to other areas, including 20 villages in two districts including Khong and Moonlaphamok districts. There have been finished creating seven fish conservation zones in seven villages. The fish conservation zones project will not only protect fish and aquatic animals but also focus on villagers improving livelihoods and provide technical skills related to animal husbandry and other skills to the community.

However, the project is not as practical as it should be because people are not in touch with the importance of fish conservation zones and not strictly in implementing a related. It shows there are still many fishermen who are illegally fishing in areas. The problem can be solved by raising awareness, creating stable jobs, with the participation of the people, and the strict implementation of the unit involved, but it would cost more. One option that will be effective is the contribution of the people in the area to create awareness and responsibility for themselves. Consequently, the willingness to pay a contribution to protecting fish conservation zones will be the theme of the investigation of our research team. This research focuses on primary and secondary data analysis, which involves collecting the data by questionnaire to estimate the value and factors of the people's willingness to pay for the Fish Conservation Zones a case study from Khong District, Champassak Province.

2. Materials and Methods

2.1 Study area: the Lower Mekong River Basin

The Mekong River is Southeast Asia's longest river. It begins a 4,200-kilometer trip through the Tibetan Plateau's mountains. It then flows through China, Lao PDR, Myanmar, Thailand, Cambodia, and Vietnam before reaching the South China Sea. It ranks eighth in the world for annual water volume (>475 billion m^3). The river with its numerous brooklets, backwaters, lakes, and wetlands supports many unique ecosystems, biodiversity, and a diverse spectrum of internationally threatened species. The productivity of the Mekong River Basin is built on a dramatic process of flooding and recession, which provides a diverse range of habitats throughout the basin (Commission, 2003).

The Lower Mekong River Basin (LMRB) comprises the Mekong River Basin in Cambodia, Laos, Thailand, and Vietnam. It has a population of 62 million people and an area of 606,000 square kilometers. The basin encompasses 795,000 km2 and includes parts of Myanmar as well as China's Yunnan Province. The Basin encompasses 86% of Cambodia's land area, 97% of Lao PDR's land area, 36% of Thailand's land area, and 20% of Vietnam's land area (Commision, 2013). This ecosystem is critical to the viability of natural resource-based rural livelihoods for the

Lower Mekong Basin's 55 million citizens, which is equivalent to more than 90% of the population of the entire Mekong Basin and roughly one-third of the total population of Cambodia, Lao PDR, Thailand, and Vietnam combined (Campbell et al., 2009).

Following the Amazon, the LMRB is the world's second most diverse river, supporting the world's largest freshwater capture fishery of around 2.3 million tons/year with an estimated mercantile value of US $2 billion/year (Dao et al., 2010). Despite reports of falling catches, the river's yearly flood pulse continues to advocate a productive fishery. The basin is one of the world's most productive interior fisheries basins. It supplies a diverse range of breeding natural environments for over 1,300 species of fish, and the river's annual rise and fall ensures a nutrient-rich environment for fish. The fishery provides a living not just for fishermen, but also for thousands of others who work full or part-time creating and selling food commodities and fishing gear, repairing boats, and providing hundreds of other services. During the wet season, the LMRB resembles a massive fishpond, teeming with aquatic plants and animals in fields, ponds, lakes, streams, and even riverbank ditches (Poulsen et al., 2002).

At its convergence with the South China Sea, the Mekong River has a total catchment zone of about 795,000 km^2 (Commission, 2011). The Mekong River is practicable divided into seven broad physiographic regions described by topography, drainage patterns and the geomorphology of river channels. The upper three regions (Tibetan Plateau, Three Rivers, and Lancang Basin) make up the Upper Mekong Basin, while the lower four regions (Northern Highlands, Khorat Plateau, Tonle Sap Basin, and the Delta) make up the Lower Mekong Basin (Pearse-Smith, 2012). With a total catchment area of about 571,000 km^2, the Lower Mekong Basin covers a large part of Northeast Thailand, almost the whole countries of Lao PDR and Cambodia, and the southern tip of Vietnam (Commision, 2013).

2.2 Mekong River Fish, Fishers, and Fishery Governance

2.2.1 Mekong River

The Mekong River, which runs through Lao Peoples Democratic Republic (Lao PDR or Laos) for 1860 kilometers, is the country's hydrological lifeline. Laos has designated around 25% of the Mekong River Basin, accounting for 35% of total Mekong flow (Organization and Aquaculture, 1999). The richness of the aquatic natural realm of the Mekong River Basin is an important feature. There are a number of rapids, deep-water pools, flooded woods, and a wide variety of aquatic species and plants (Baird and Myszka, 2001).

Naturally, the Mekong River Basin has the world's third most diverse fish population and the most fish species of any Asian river basin. The Mekong Basin may have 1200 species, though many have yet to be taxonomically represented (Rainboth, 1996).

2.2.2 Siphandone Wetlands

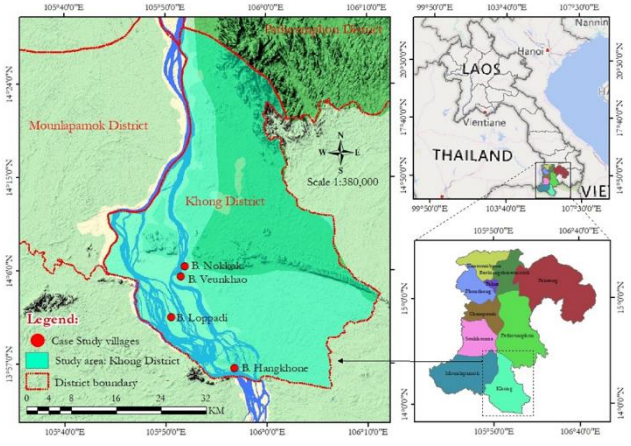
The Siphandone Wetlands are recored in the greatest south of Laos, in the territory bordering Cambodia to the south, southeast, and southwest. They are one of the most intricate biodiversity in the predominant Mekong River, made up of a abundance of huge and small inhabited and uninhabited islands, cramped channels, seasonally inundated forests, deep-water pools, rapids and waterfalls. Siphandone (in particular its southernmost sector of Khone Falls) has captivated growing scientific curiosity in recent years, regarding its role as a natural gateway for fish migrations. The complex of falls at Khone is the largest natural obstruction to the water course along the lower river basin. The fauna of the Mekong River has a very high level of biodiversity and is still far from being fully documented. The biology and ecology of the over 400 fish species yet identified in the basin are poorly known. Siphandone seems to act as an ecotone for some species due to the presence of the falls. At the same time, it provides a very wide range of niche space for the diversity of hydrological conditions and habitat structures produced as a consequence of the complex morphology of the river channel and the wide seasonal range of the river regimen. (Daconto, 2001).

2.2.3 Small-scale Fishers in Southern Laos

Because Laos is landlocked, the Mekong River and its tributaries are critical sources of fisheries catchment, which are an important source of protein as well as income creation (Sjorslev and Coates, 2000). A wide range of fishing methods are used, each based on specific environments and fishing seasons, as well as the fishers' racial and socioeconomic backgrounds. The fishing tactics used depend on the target fish species and understanding of the fish's biology and behavior (Baird, 2007). Fishers significantly contribute to people's ability to feed their family and produce revenue in these fishing-dependent communities.

Nonetheless, human populations have increased in recent years, fishing inventions have been rebuilt, markets have been more accessible, and development projects ranging from minor irrigation endeavours to huge hydropower dams have increased.

Figure 2 Illustrate Villages in Khong District with fisheries co-management regulations.



All of these have been linked to the harmful impact of concussion on fish populations (Bush, 2004). Despite the lack of official data, there are increasing reports of significant decreases in fish catches (Cooke et al., 2012). Khong District is home to over 65,000 people, most of whom are ethnic Lao rural farmhands. They are mainly semi-subsistence rice paddy farmers who have lived in

the area for a long time. People in Khong are perhaps more reliant on wild fishing catchments for a living than people in the rest of Laos. Khong has 136 settlements, 86 of which are on islands, with the majority of the rest located along the Mekong River's eastern bank. Approximately 94% of families in the district engage in artisanal fishing for sustenance or as a source of income. In 1996/1997, it was projected that 4,000,000 kgs of fish were taken in Khong Area, and that over US$ 1 million in wild fish and fish products from Khong were marketed outside of the district (Baird and Flaherty, 2005).

2.2.4 Fishery Governance

In the Mekong River Basin, capture fisheries administration faces numerous challenges that, if left unaddressed, have the potential to cause significant habitat degradation that crosses multinational boundary (Baird, 2006). For example, the Yali Falls dam in Vietnams Central Highlands has already created remarkable concussion downstream in northeast Cambodia (Hirsch and Wyatt, 2004). The Mekong River Commission (MRC), which should disentangle the solving of consequential cross border freshwater resource supervisory problems like this one, it has so far failed to be efficacious (Baird, 2013). Barrage built in Laos are imagined having had a serious negative impact on fisheries (Goldman, 2001), nevertheless observational figure about fisheries resources is elimited and disintegrated (Baird, 2007). There is large capacity gaps anaalysis regarding the many small-scale fishers managing throughout the Mekong countries (Baird, 2011). Moreover, the Mekong basin structure has nemberous fisheries, some large and others small, each operating differently, which adds even more complexity to the issue of improving effective management scheme (Claridge et al., 1997). Many fisheries are rural, making government conduct challenging, costly, and regularly improbable (Cunningham, 1998). Centrally imposed natural resource management systems typically require specific amounts of human and financial resources from governments or organizations to closely monitor and regulate resource utilization.

Regrettably, the fishing sectors in the Mekong Basin are commonly understaffed and underfunded (Kottelat and Whitten, 1996). The Mekong Basin flows within the national boundaries of six nations, China, Burma, Thailand, Laos, Cambodia, and Vietnam, increasing the complexity. Many fish species dislocate, connecting two or more of those countries, and are highly impermanent (Poulsen and Valbo-Jørgensen, 2001). Regardless of the challenges mentioned earlier, local fisheries can still significantly enhance fish stocks. Some fish migrate only locally or are relatively sedentary (Rainboth, 1996). There is also a potential for synergistic and cumulative positive impacts when nearby villages independently take responsibility for fish stocks in their individual control areas (Poulsen et al., 2001). Essentially, the more local people participate, the more positive results can be distributed to local livelihoods and scaled up. Issues addressing significantly improved natural resource management, alternative career optimization, and increased opportunity income generation, but relying on local communities to regulate fisheries, are gaining traction, not just in the Mekong region (Pollnac et al., 2001).

In Laos, the wetland of the LMRB encourages a huge variety of ecologically, some of which are recorded to be rare, vulnerable, or threatened. This study focuses on economic approaches to a willingness to pay (WTP) Chen et al, (2018), in conducting FCZs at the target villages, Khong District, Champassak Province, using market valuation methods under fair market conditions.

The models used to identify the value of willingness to pay are:

$$\text{Prob}(\text{WTP} = 1) = \alpha + \beta\text{Bid}$$

Consequently, we are going to find the median WTP of those who are willing to pay

$$\text{Bid}Medain = -\frac{\alpha}{\beta} \text{ or } WTP_{Medain} = -\frac{\alpha}{\beta}$$

The model used to test the factors that affect the willingness to pay for the FCZs protection of the reserve is the Logit model, with Y = 1 when the respondents are willing to pay, if not willing to pay, set to Y = 0.

Hence, the opportunity arises in an interested case

$$\Pr(y = 1) = \frac{1}{1+e^{-x'\beta}} \quad (1)$$

Opportunity for non-events of interested to be studied:

$$\Pr(y = 0) = 1 - \Pr(y = 1)$$

Insert equation (1) we will have the equation of Pr (y=0) = 1-$\frac{1}{1+e^{x'\beta}}$

$$\Pr(y = 0) = \frac{e^{-x'\beta}}{1+e^{-x'\beta}} \quad (2)$$

An opportunity in the case of an interested event and a non-interested event will be held in the odd equation as following:

$$\frac{\Pr(y=1)}{\Pr(y=0)} = \frac{\left(\frac{1}{1+e^{-x'\beta}}\right)}{\frac{e^{-x'\beta}}{1+e^{-x\beta}}} = e^{x'\beta} \quad (3)$$

The model used to find the factors that affect the event of interest by converting it to a straight-line equation can be written as follows:

$$\text{Ln}\left(\frac{\Pr(y=1)}{\Pr(y=0)}\right) = \beta\text{X} = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \ldots\ldots + \beta_k X_k + \mu$$

Where y is a variable with two values: 1 and 0 Prob (y = 1) is the chance of an event that we are interested in studying, where y is equal to 1, and when Prob (y = 0) is the chance of an event that we are not interested in, which y is equal to 0 (Gasso, 2019).

Variables X_1,X_2,X_3....X_k are independent variables that influence the variables according to Y or the probability of an event that we are interested in studying, which will indicate how much

each variable variables influence the variables depending on the parameter values $\beta_1, \beta_2, \beta_3, \ldots \beta_k$, The value β_0 refers to the value of other factors that we have not studied, but also have an effect on the variable Y as well.

Thus, in studying Factors Affecting Fisherman Willingness to Pay for the FCZs a case study from Khong District, Champassak Province. The simulation model was applied in accordance with the following study objectives:

$$Ln\left(\frac{Pro(WTP=1)}{Pro(WTP=0)}\right) = \alpha + \beta_1 Bid + \beta_2 Sex + \beta_3 Age + \beta_4 Mjob + \beta_5 Edu + \beta_6 Memb + \beta_7 Are + \beta_8 Lninc + \beta_9 LnExp + \beta_{10} Ni + \varepsilon$$

WTP refers to the willingness to pay for the protection of a protected area, which is defined as a variable with two values: WTP = 1 is willing to pay and WTP = 0 is not willing to pay at a fixed price. $Mjob$ is the main occupation, Edu is the education level, $Memb$ is the number of fisherman household members, $Incom$ is the average monthly income of the household, Exp is the average monthly expenditure of the fisherman household, and NI is recognition of necessity of the fish conservation zones knowledge, α is the constant, β is the coefficient of each independent variables, ε is an error term.

To estimate the impact on the Marginal Effect, to estimate how much the independent variables will change when the value of one variable changes to one WTP variable, as shown equation below:

$$Marginal\ Effect = \frac{\partial \Pr(\text{WTP} = 1)}{\partial X_n}$$

The logistic regression model was proved to identify variables that affected the respondents' decisions on willingness to pay for fish conservation zones. The dependent variable was bid offering, gender, age, job, family member, occupation, education, recognition of the necessity of the fish conservation zones, environmental organization, monthly household income, and monthly household expenditures.

2.3 Contingent valuation method concept

The contingent valuation method (CVM) is the econometrics tool which being used to valuate both use and non-use values. CVM is the most popular method for analysising non-use values and is also the most disputatious of the non-market valuation methods. CVM is named contingent valuation because respondents are asked to reply to their willingness to pay for a specific hypothetical scenario and confession of the environmental service.

This method ordinarily includes a survey of a sample of people on the amount of money they are willing to pay for some aspect of biodiversity. It has improved and conserved (Thibodeau and Ostro, 1981).

The CVM is a widely popular method for evaluating biodiversity and has more potential for capturing its more abstract benefits than revealed preference techniques.

The CVM is flexible and well done when estimating values for environmental suvices payment, easy to identify and understood by the user. Data anlysis through CVM are reliable and reasonable.

Table1 Shows the sample size of the population and sample group.

No	Village name	Population's households	Sample's households
1	Hang-khone	213	102
2	Loppadi	305	147
3	Nokkok & Veunkhao	250	120
	Total	768	369

2.4 Data

2.4.1 Population and sample groups

Population: The population used in this research is based on the current location of fish conservation zones, which is located in the vicinity of, Khong District, Champassak Province, with a total population of 768 households. The sample group used in this analysis was obtained from random sampling from the population in each village, which was obtained from the random calculation formula of Asnawi and Hafizrianda, (2017) from a total population of 768 households.

$$n = \frac{N}{1 + N(e)^2}$$

$$n = \frac{768}{1 + 768(0.05)^2} = 263.014 \approx 264$$

Where:
n = size of sample group
N = population size
e = projection value sample

Increasing the reliability of the data, in this study, a total of 369 samples were identified to represent the population. For the selection of the sample size in each village, it is based on (Sayvaya and Kyophilavong, 2015) which uses the formula:

$$n_i = \frac{(N_i * n)}{N} \text{ whereas } i = 1, 2, 3 \ldots .14$$

Where; n_i is the number of samples in each village and N_i is the population in each village.

2.5 Data collection in the research field

2.5.1 Primary data

For primary collecting is the data collection from people which living nearby fish conservation zones with questionnaire method in order to ask about the willingness to pay for fish conservation zones, by asking for willingness to pay, a hypothetical event is created by explaining the details of the hypothetical situation and then asking the public for their opinion on whether or not they are willing to pay by choosing to interview the head of the household or a household member who is 18 years old or older. The steps to collecting information for use in this study were to query the initial test (Pretest) target groups to test their understanding of the respondents to the questionnaire and check that they had complete information on the purpose of education, or query the coming modifications to make a complete end after the query is complete and we will be doing the actual survey of fisherman in the target villages, which clearly meets the purpose of this research the most obviously.

3. Results and discussion

3.1 The demographic characteristics

The descriptive analysis is shown in Table 2. found that there were 257 males (69.65%), and 112 females (30.35%). The gap of ages between 36–40 (6.23%), under the age of 30 (2.98%). 311 people were married (84.28%) and single (6.23%). There were 134 people who completed primary school (36.31%), completed secondary school, (21.14%). There were 57 people who had not enrolled in school (15.45%), graduated with bachelor's degrees (8.67%), high school (8.13%), completed diplomas (4.88%), completed vocational school (2.44%). There were 5-6 members in 170 households, (46.07%), with 7 or more members (22.76%), 3-4 members (26.29%), and 1-2 members (4.88%). There were 214 people who were farmers (57.99%), government officers (15.72%), fishermen (15.99%), livestock (5.69%). The majority of agricultural land is between 2-3 hectares (65.04%).

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Table 2 The demographic characteristics.

Demographic characteristics	**Frequency (People)**	**Percentage (%)**
Sex		
Female	112	30.35
Male	257	69.65
Age		
0-30	11	2.98
31-35	10	2.71
36-40	23	6.23
41-45	46	12.47
46-50	59	15.99
50+	220	59.62
Status		
Single	23	6.23
Married	311	84.28
Divorced	35	9.49
Education		
No enrolled school	57	15.45
Primary school	134	36.31
Secondary school	78	21.14
High school	30	8.13
Vocational	20	5.42
Diploma	18	4.88
Bachelor degree	32	8.67
Household number		
1-2	18	4.88
3-4	97	26.29
5-6	170	46.07
7+	84	22.76
Main occupation		
Farmer	214	57.99
Livestock	21	5.69
Fisherman	59	15.99
Marchant	6	1.63
Boat driver	4	1.08
Worker	7	1.90
Government officer	58	15.72
Agriculture land, Hectare		
0-1	83	22.49
2-3	240	65.04
4-5	41	11.11
6-7	2	0.54
8+	3	0.81
Average income, $USD/month		
0-103.98	99	26.83
103.99-207.95	144	39.02
207.96-311.93	88	23.85
311.94-415.90	23	6.23
415.91+	15	4.07
Average income	211.46	
Minimum income	103.98	
Maximum income	1,122.94	
Average expenditure, $USD/month		
0-51.99	79	21.41
52-103.98	132	35.77
103.99-207.95	124	33.60
207.96-311.90	24	6.50
311.91+	10	2.71
Average expenditure	130.72	

Minimum expenditure	103.98
Maximum expenditure	1,060.56

Source: Interviews from 369 respondents; 10/03/2021-31/08/2021

There were 41 households with agricultural land between 4-5 hectares (11.11%). The average household income was about $211.46 USD/month. The average expenditure was $130.72USD/month.

3.2 Opinions on biodiversity for Fish conservation zones

The research results described local community concerned biodiversity loss of the Mekong River, Table 3. They had the highest positive agreement with 83.29% of respondents on the fish species are the main household income generation of local people. The other positive response was 82.36% agreed with the statement that FCZs made fished and aquatic animals sustainable; 70.18% fish conservation zones were very crucial on the local community; 78.11% agreed with the statement fish conservation zones increase the species of biodiversity and other aquatic animals; the respondents on fish conservation zones made more supply chain and household income 74.83%. The statement on fish conservation zones ensured future economic stability and food security 73.68%. Fish species of Mekong River had decreasing 72.19%. and the lowest agreement on the statement fish conservation zones is the responsibility 71.36%. As the reported of Commision, (2013). The Mekong River is the lifeblood of 60 million people, of which about 75% live in rural areas and depend on the Mekong River for livelihoods and food security. The Mekong River is also biodiversity rich with over 850 fish species identified. We need to make fish conservation zones to increase more species and biodiversity.

3.3 Bidding offered for fish conservation zones protection

In this study, 369 questionnaires were collected from the target villages. There were 5 biddings offered for fish conservation zones, including 1.04 US $, 2.08 US $, 4.16 US $, 8.33 US $, and 16.66 US $ corresponding. They had the highest positive agreement with 91.89% in the bidding offered as 1.04 US$, there was a positive agreement with 74.32% in the bidding offered as 2.08 US$. The bidding noted is 63.51% with a positive agreement in the bidding offered at 4.16 US dollars. The highest agreement was 54.05% on the statement agreement, with a bid of 8.33 US dollars, and the lowest agreement was 32.88 % on the fish conservation zones, with a bid of 16.66 US dollars.

3.4 Willingness to pay for fish conservation zones

The estimated log-logistic regression of mean willingness to pay for charges in the attribute levels in fish conservation zones is presented in Table 5. It is statistically significant at a 99 % confidence level.

$$WTP_{median} = -\frac{1.591374}{0.0000164} = 12.12\ US\frac{\$}{year}$$

The value of the people willing to pay for the protection of fish conservation zones is estimated at 12.12 US $/household/year, and the total value was 9,310 US $/year. These values can be calculated as the cost of administrative funds to protect the habitats of the target villagers. The figure compared to the fact that it may cost a little more, but in reality, in the region, especially in the village near the river with its fishing professional principles, there are many households, assuming that the project is implemented, may have agreed to all villages in nearby Thus, when evaluating the value of protected areas, conservation will be valued higher, which could make the project come from the actions that are effective.

3.5 Factor effecting willingness to pay for fish conservation zones

The model tested in this study was log-logistic regression is used to estimate the parameter, the investigation results of Marginal Effect of Maximum Likelihood are declarative in Table 6. Significant positive correlations were found between the household's willingness to pay and bid offering and statistically significant at a 99 % conference level. The findings also confirmed that the villager's income contribution to willingness to pay for FCZs in positive significant at a 90% confidence level. Specifically, a positive significant of recognition of necessity of the fish conservation zones knowledge, for instance; 1% of recognition of necessity of the fish conservation zones knowledge increase will boost Willingness to Pay for Fish Conservation Zones by 50.18%.

4. Discussion

The research result involved the local people's opinion on fish conservation zones being in positive agreement at a high percentage. The local people were apprehensive about the fish species because they are the main household income of the local community, and they mentioned that conservation zones made fish and aquatic animals sustainable. They knew that fish species were important to their livelihoods. If fish species were damaged, food insecurity would be increased as well.

Table 3 Percentage of agreement and disagreement on fish conservation zones.

	Statement	Percentage	
		Agree	Disagree
1	Fish conservation zones made fishes and aquatic animals sustainable.	82.36	17.64
2	Fish conservation zones increase the species of biodiversity and other aquatic animals.	78.11	21.89
3	Fish conservation zones ensure future economic stability and food security.	73.68	26.32
4	Fish conservation zones made more supply chain and household income	74.83	25.17
5	Fish conservation zones were very crucial on the local community	80.21	19.79
6	Fish conservation zones are the responsibility of villagers to contribute	71.36	28.64
7	Fish species of the Mekong River has decreasing	72.19	27.81
8	Fish species are the main household income of local community	83.29	16.71

Source: Interviews from 369 respondents; 10/03/2021-31/08/2021

Table 4 Percentage of agreement and disagreement on bid offering.

Bid: US $/Year	Agree	Percentage	Disagree	Percentage
1.04	68	91.89	6	8.11
2.08	55	74.32	19	25.68
4.16	47	63.51	27	36.49
8.33	40	54.05	34	45.95
16.66	24	32.88	49	67.12

Source: Interviews from 369 respondents; 10/03/2021-31/08/2021

Table 5 Analysis of the value of willingness to pay.

WTP	K	Z	P>z
Bid	-0.0000164***	-7.05	0.000
Cons	1.591374***	8.32	0.000
Log likelihood	-214.25423		
Number of observations	369		
LR chi (1)	56.14		
Prob > chi2	0.0000		
Pseudo R2	0.1158		

Source: Interviews from 369 respondents; 10/03/2021-31/08/2021
Note : *** confidence level at 99%

Table 6 Factors affecting willingness to pay for fish conservation zones.

Independent	Maximum Likelihood			Marginal Effect		
Variables	k	Z	P>z	dy/dx	Z	P>z
Bid	-.0000184	-6.95	0.000	-0.00000417 ***	-6.93	0.000
Sex	0.0782296	0.28	0.782	0.0178298	0.28	0.783
Age	0.0166806	1.24	0.216	.0037846	1.24	0.216
Job	0.1392159	0.33	0.745	0.0310492	0.33	0.740
Edu	0.0752407	0.22	0.825	0.0169469	0.22	0.824
Memb	-0.0131946	-0.18	0.859	-0.0029937	-0.18	0.859
Are	-0.0422981	-0.41	0.684	-0.0095969	-0.41	0.684
Lninc	0.538442	1.89	0.059	0.1221654 *	1.89	0.059
Lnexp	-0.2697333	-1.26	0.209	-0.0611989	-1.26	0.209
n1	2.267336	4.17	0.000	0.501857***	5.94	0.000
_cons	-5.187516	-1.61	0.108			
Number of ops	369					
LR chi2(10)	88.89					
Prob > chi2	0.0000					
Pseudo R2	0.1813					

Source: Interviews from 369 respondents; 10/03/2021-31/08/2021

Consequently, it was the crucial reason the local people deliberatd to pay for FCZs. Significant positive correlations were found between the household's willingness to pay and bid offering and statistically significant at a 99 % conference level as a study of Mamat et al, (2013) and Tonin, (2018). The findings also confirmed that the villager's income contribution to Willingness to Pay for FCZs in positive significant at a 90% confidence level likes the investigation of Choi et al, (2017) and Abd Rahman and Matthew, (2021). Specifically, a positive significant of recognition of necessity of the fish conservation zones knowledge, for instance; 1% of recognition of necessity of the fish conservation zones knowledge increase will boost Willingness to Pay for FCZs by 50.18%. In the case of Khong district, Champasak province, Lao PDR, in the theme of fish conservation zones. The research results recommend that the government work directly with the fisheries department on collaborating between NGOs and fisheries experts for an issue addressing and more solutions through creating environmental awareness schemes for the local people on topics of the environment, which can be practical and cost-effective. These policies would conserve the natural biological diversity of LMRB and improve the sustainable quality of life in the southern region of Laos.

The primary objective of research conducted on WTP for FCZs is the samples were collected by purposive sampling from 369 houses in 3 target villages, including Ban Hang khone, Ban Loppadi, and Ban Nokkokveunkhao in Khong district, Champasak province, and the Southern region of Laos. The research used single-bounded closed-ended CVM questions and a logistic regression model with maximum likelihood for marginal effect as a tool to analyze the data. The results concluded that the WTP for FCZs by the mean of a logistic regression model was 12.12 USD/household/year and the total value was $9,310 USD/year. This finding also revealed that the positive correlation of a household's willingness to pay for FCZs included bids offering, household income, and recognition of the necessity of the fish conservation zones. These results can be used in the decision-making of policy makers regarding the three pillars of green growth, including environmental, social, and economic sustainability, for the feasibility of biodiversity sustainability.

Sustainability means being of the present without compromising the needs of future generations. Thus, FCZs have traditionally been established by local people and are still limited in some rural areas as village common assets with community-based administration or even concerned sacred places. The improvement of FCZs is not only good for aquatic biodiversity conservation but also for improving local people's nutrition significantly and for maintaining riverbank or biodiversity, ecology, and natural water source forest areas that contribute to their additional income and optimize alternative occupation opportunities, which could also be connected to ecotourism.

The success of FCZs has typically been achieved by the local people, who have adopted regulations involving banning the utilization of certain fishing gears and methods; banning or limiting fishing in key deep-water areas, which are refuges or habitats for fish during the dry season; protecting fingerlings and juvenile fish during the egg-laying season, which provides fish growth; increasing the fish population while also protecting the ecosystem and managing natural resources in riparian areas. However, the most productive FCZs are those located near or within a village. Some can even serve as tourist attractions because they are easier to protect, and local people are proud of FCZ ownership. Taking into account the very rich fish diversity of the rivers and streams in the southern region of Lao PDR, there is, in principle, great potential to develop and fully operate FCZs throughout.

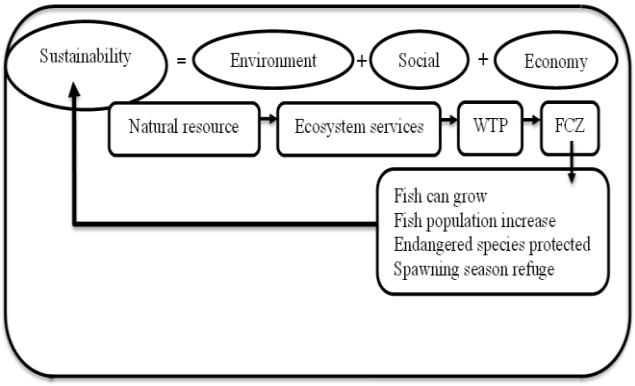

Figure 3 Relationship of FCZ with sustainability.

Establish and train an FCZ committee within the village government committee to conduct on FCZ protecting co-management, surveillance, and security in accordance with operational guidelines and regulations agreed upon and shared by local people and stakeholders. Provide community members with orientation and training on local network responsibilities and obligations for conducting sustainable co-management and curb of FCZ and have a jurisdiction that typically corresponds to the village of FCZ and its riparian areas; Enforce strict fish catch limits in the FCZ area, primarily to prohibit all illegal fishing methods and the use of dangerous fishing equipment. Also, to enforce the implementation of the "Fishery Law" that pointed out and related to the "Protection of aquatic habitats and ecosystems.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have influenced the work reported in this paper.

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