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Determinants of Rice Farmers' Willingness to Pay for Conservation and Sustainable Use of Swampy Wetlands in Ghana's Northern and Ashanti Regions

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Abstract: In light of the increased importance of sustainability issues in the world economy, this study calculates the economic value of the swampy wetlands in Ghana's Northern and Ashanti region, based on rice farmers' and community members' willingness to pay (WTP) for the sustainable use of the wetlands. It also examines the factors influencing this WTP. Data from 160 rice farmers and community members in four districts were collected via a questionnaire survey. A logistic regression model was employed to determine the significance of the influencing factors, while the respondents' WTP was estimated by the contingent valuation method. The results revealed that 89.4% of the respondents were willing to contribute about 54.90–213.11 USD/household/ha/year and an aggregated 0.298–1.158 million USD/year to ensure swampy wetland sustainability. On an average, they were willing to pay 180.17 USD/household/ha/year and an aggregated 0.979 million USD/year. Gender, household size, household disposable income, and knowledge of the importance of wetlands were found to be the determinants of WTP. We recommend that farmers and the public be educated on wetland ecosystems and family planning. In addition, reducing household size and providing rice farmers with adequate irrigation and postharvest facilities are worthwhile conservation measures.

Keywords: Ghana; postharvest losses; swampy wetlands; willingness to pay (WTP); contingent valuation method (CVM)

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1. Introduction

Wetlands play a vital role in the sustenance of living organisms through the provision of a diverse range of ecosystem services vital to their well-being [1]. Wetlands are described as "areas of marsh/swamp, fen, peat land or water, whether natural or artificial, permanent or temporal, with water that is static or flowing, fresh, brackish or slat, including areas of marine water, the depth of which at low tide does not exceed six meters" [2]. They support livelihoods for those who generate income from agricultural production, contribute to social and cultural well-being, and have aesthetic value for humans [3,4]. As a natural resource, wetlands provide a range of services (such as regulation of hydrological flows, storage, and retention of water, and erosion control and sediment retention) [5], and their products have high economic value [6–8]. According to Constanza et al. [9] and the Millennium Ecosystem Assessment [10], their functions can be classified as provisioning, regulating, and controlling, and they play treatment, cultural, and supporting roles. Across the world, people use and appreciate the plants, animals, and minerals in the wetland ecosystem [11].

Despite its importance as a life-support system, swampy wetlands have suffered from degradation and ecological damage in many countries [10,12]. Ghana is no exception to this trend, and factors such as the disposal of solid and liquid waste (including chemical residues and sewage effluents), agriculture, mining, and other land use changes have contributed to the degradation and damage of Ghanaian wetlands [13,14]. Agriculture, when incorrectly practiced (e.g., the indiscriminate use of fertilizers and chemicals to control weeds, pests, and diseases in swampy wetlands, and continuous or over cropping), contributes to wetland degradation and damage [15]. However, agriculture has sustained Ghana's economy for decades: it contributed to 18.3% of the nation's gross domestic product in 2017 [16], and it employs approximately 50.6% of all workers, providing 80% of their incomes [17,18]. Most Ghanaian farmers largely depend on the swampy wetlands for crop production, which provide them with income and livelihood. For example, rice farming mostly takes place in swampy wetlands, and rice farmers are heavily dependent on this area, which accounts for approximately 78% of the domestic rice production [19]. However, a feasibility study by Galbraith et al. [12] found that overreliance on swampy wetlands for rice production is influenced by postharvest losses and inadequate irrigation facilities since effective irrigation enhances the ecological resources of the wetland.

High postharvest losses in rice have been a menace for Ghanaian farmers. Manful and Fofona [20] estimated quantitative postharvest losses in Sub-Saharan Africa at between 10% and 22%—accounting for qualitative losses could push this figure to 50%. Appiah et al. [21] found that Ghana's harvesting losses accounted for 4.07%–12.05% of production, threshing losses for 2.45%–6.14%, storage losses for 7.02%, and drying losses for 1.66%. These losses have reduced small-, medium-, and large-scale rice farmers' net income.

To compensate for the income loss, rice farmers tend to expand their farms, leading to an expansion of the overall farmed area (Figure 1). This overexploitation has resulted in the environmental degradation of the country's wetland ecosystem [22]. Increasing the use of land for rice production implies that the size of the virgin swampy wetlands is reduced. Additionally, the swampy wetlands are destroyed by continuous cropping, use of fertilizers, and use of chemicals to control weeds, diseases, and pests. This has in turn destroyed the habitats for terrestrial and aquatic plants and animal species [23]. Thus, exploiting the swampy wetlands for farming carries the great risk of widespread destruction of the swampy wetland ecosystem.

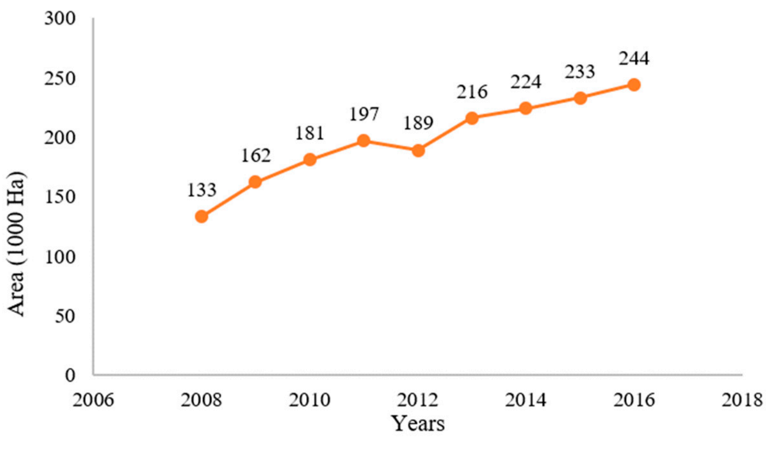

Figure 1. Increase in the area of swampy wetlands used for rice production in Ghana (Reproduced from [24], with permission from ICT and Data Management Services, 2020).

Many people tend to exploit wetland resources for their socio-economic benefits [25]. The use of swampy wetlands for small-, medium-, and large-scale rice farming has improved farmers' well-being [26], as being able to access wet paddy fields for continuous farming has increased their net income. However, the resulting land degradation renders the swampy wetlands incapable of performing their ecological functions, such as carbon sequestration and flood regulation [26]. Their sustainability is threatened, especially if their worth is not recognized by the users. Therefore, the objectives of this study are to (1) determine how much rice farmers and community members are willing to pay for the sustainable use of swampy wetlands, and (2) identify the factors contributing to rice farmers' and community members' WTP for the sustainable use of swampy wetlands.

Wetland sustainability is vital for all forms of life, and several studies across the globe have examined the factors contributing to it. In Ghana, most studies on wetlands have focused on water quality and pollution [27–30], conservation of Ramsar sites [13,31,32], economic value of wetland resources from the perspective of fishing [33], and factors contributing to their ecological damage (land use change, mining, waste disposal, and agriculture) [13]. Although rice farmers are one of the major stakeholders in the utilization of swampy areas, there are no studies on their contribution to the sustainability of swampy wetlands. This study fills the gap by investigating the rice farmers' WTP for the sustainability of swampy wetlands and by determining the factors that influence their decisions. On the basis of the findings, recommended measures to ensure that wetlands are used sustainably are outlined. As WTP can help policymakers to price, for example, the environmental resources that have no market price, knowing the farmers' WTP can help with the formulation of future policies to ensure the sustainability of such resources.

2. Valuation of Swampy Wetlands

Ghana became a signatory to the Ramsar Convention in 1988, with the core mandate of the principle of "wise use" of wetlands, which can be understood as "their sustained utilization for the benefit of humankind in a way compatible with the maintenance of the natural properties of the ecosystem" [34] (p. 3). In June 1999, the country established a national policy to ensure judicious utilization of its land and natural resources, which included a strategy to promote sustainable use of wetlands for farming, grazing, fishing, and timber production [34]. However, policymakers and enforcement agencies have not been able to ensure sustainable use or discourage encroachment upon the wetlands. The principle of "wise use" has been overstretched, resulting in overexploitation and overdependency on wetland resources, consequently damaging national resources [13]. This also results in biodiversity loss and may impose a high cost of ecosystem maintenance and restoration in the future. The ecosystem is mostly assumed to be a public good and free for everyone to use because its value has not been established and appreciated [35].

To better understand and appreciate the wealth of the swampy wetland, this study focused on economic valuation, which is an assessment method, in order to measure and compare the different benefits derived from wetlands [6]. Establishing the economic value and the influential factors can enable the wise use and management of swampy wetland resources [6]. Prior studies have used the contingent valuation method (CVM) to determine the WTP by pricing resources (benefits) in wetlands that have no market value. Navrud and Mungatana [36] in Kenya used the travel cost method and CVM to estimate the value of Lake Nakuru National Park at 7.5–15 million USD. Ikiara et al. [37] also used the CVM and market price approaches to conduct similar studies and estimated the WTP for Yala wetlands at 120.4 million USD. In Malawi, Makwinja et al. [38]) used CVM to estimate the WTP to improve water quality in Chia lagoon, and Limuwa et al. [39] adopted the same approach to evaluate small-scale fishers' perception of climate change and coping strategies. It was found that communities' WTP for environmental sustainability and improved water resources management is dependent on their perceptions of the resource [40].

Several studies have considered factors that influence the WTP for wetland conservation and the amount that users or households are willing to pay. WTP and the factors influencing it vary geographically. Oduor et al. [35] studied the conservation of Nyando wetlands in Kenya and found that residents' WTP and aggregated WTP for wetland conservation were 16.7 USD/household/ha/year and 0.4 million USD/year, respectively. The contributing factors were the household head's gender and age, household size, and education. In a similar study conducted in 2011, Costanza et al. [41] estimated the annual worth of the world's ecosystem services at 125–145 trillion USD.

Kong et al. [42] examined the ecological compensation for China's Poyang Lake wetlands and found that households were willing to pay 64.39 USD/household/year. The authors also revealed that household income, location of residence, the arable land area, and the contracted water area significantly influenced their WTP. In Uganda, Emerton et al. [43] estimated the agricultural economic value of the Nakivubo wetlands at 500 USD/ha. The economic value of South Africa's harvestable resources in the Olifants River catchment area was estimated at 1–14 USD/ha/year [44].

3. Materials and Methods

3.1. Study Area

The study was conducted in two regions, Ashanti and Northern Ghana, comprising four districts: Adansi North and Adansi South (both in the Ashanti Region), and Kumbungu and Mion/Yendi (in the Northern Region).

Agriculture continues to be a major source of livelihood for the people in the study area, and only a few engage in the service sector. In the Adansi North district, 74.2% of households are engaged in agriculture; the figures for the other districts are 73% in Adansi South, 95.4% in Kumbungu, and 92.1% in Mion (Yendi). The people are dependent on subsistence crop farming, such as rice, maize, cassava, and millet, with only a few farmers engaged in animal rearing [45]. Adansi North district has 1750 farmers engaged in rice production, Adansi South has 7500, Kumbungu district has 18,868 [46], and Mion has 5391 farmers [24]. The total number of rice farmers in the study area is 33,509 across 5433 households [24]. The location of the study area is shown in Figure 2 below.

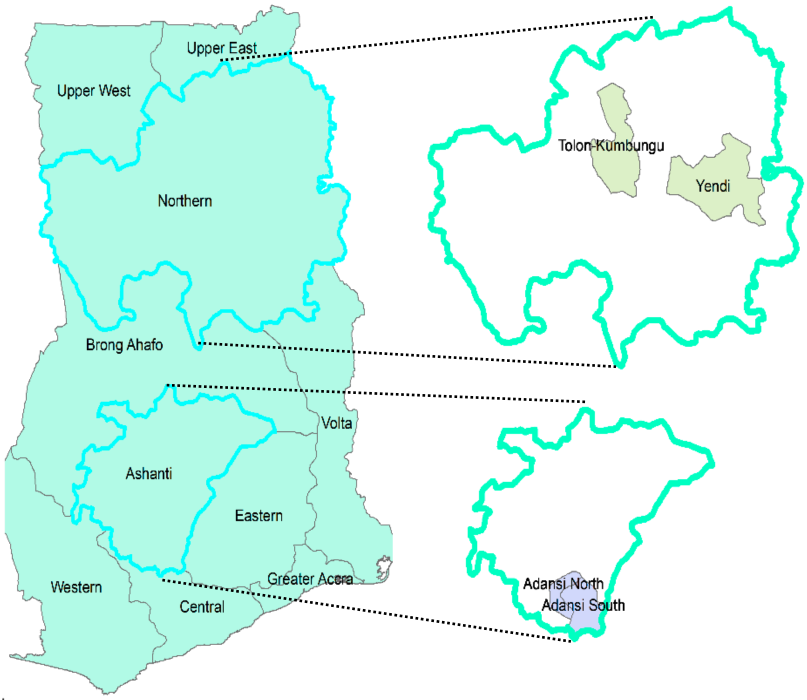

Figure 2. Map of the study area (reproduced from [47], following copyright regulation of Geofabrik GmbH and OpenStreetMap Contributors, 2018).

3.2. Sampling Technique and Data Collection

This research focused on rice farmers and community members in the four selected districts. These districts and communities were chosen because they constitute the rice-growing districts, and relevant data are easily accessible. Rice farmers and community members were randomly sampled. Consent was sought from the participants for their inclusion in the study, with the assurance that the information collected from them would be treated confidentially. The study used a sample of 160 people, comprising 30 rice farmers and 10 community members from each district. Data (such as respondents' source of income, educational level, etc.) were collected from the respondents through a questionnaire survey, with a 100% response rate, and were analyzed inductively and descriptively. The questionnaire included both open- and closed-ended questions. Information such as demographic characteristics, production level of rice farmers, farm size, land type, and WTP to conserve wetlands, was collected.

Alongside these data, the data on postharvest loss of rice were also collected to ascertain their effects on swampy areas, as well as information on the type and size of land under rice production, whether or not there was any increase in size in the past five years and the reasons for the increase.

3.3. Data Analysis

A CVM of the stated preference approach was used for the economic valuation of the swampy wetland ecosystem, which helps in shedding light on the value of sustainable use and conservation. The method was used to measure individual preferences in monetary terms [48,49] and to price resources (benefits) in wetlands that have no market value (social cost) [9,35,42,50–53]. In comparable studies, individuals have often been asked to state the maximum amount they would pay for improved environmental quality [48]. Some scholars argue that individuals' stated intentions in a CVM study differ from actual practice, and thus doubts exist of whether CVM can be a valid measure for monetary valuation of public goods and services [54]. Nevertheless, scholars and policymakers accept CVM as a useful tool to estimate the monetary value of nonmarket goods or services [9,55]. Johnson et al. [54] and Armbrecht et al. [56] noted that CVM estimates both the use and nonuse values of goods and services. It is one of the most widely used tools by academics and policymakers for the economic valuation of the resources, environmental goods, and services that are not traded in regular markets or when market transactions are difficult to observe under conducive conditions [57]. In this study, WTP was used to assess the amount that respondents were willing to pay for the sustainability of the swampy wetlands [58]. According to Loomis [59], open-ended (OE) and dichotomous choice (CD) are the most common designs, although he prefers OE designs because it outperforms DC on temporal stability grounds. Interestingly, Brown et al. [60] found that DC designs resulted in a relatively greater hypothetical error, that is, these designs showed a greater difference between stated and actual WTP. OE design also offers a degree of flexibility in estimating the WTP amount curve [58]. Thus, OE was used because it allows respondents to respond with the maximum amount they would offer, without restrictions [61], thus improving the precision of WTP estimates [62]. According to Alberine et al. [63], open-ended questions capture the behavior of consumers in regular markets; they also minimize standard error [64], enable estimates of central tendency, and prevent bias [48].

Thus, WTP was assessed using the following model as it has been popular among several researchers, including Kong et al. [43]:

$$E(WTP) = \sum_{i=1}^{n} \alpha i Pri \quad (1)$$

where *E(WTP)* is estimated willingness to pay (weighted average), αi is the amount farmer household *i* is willing to pay, *Pri* is the probability that a farmer household ***i*** will pay that amount, and ***n*** is the sample size of farmer households whose WTP is positive. On this basis, the weighted average WTP of the respondents was calculated.

The economic value of the swampy wetland was calculated by the following model:

$$EVSW = WAWTP\ (\$/yr/ha) \times HHP \quad (2)$$

where *EVSW* is the economic value of the swampy wetland, *WAWTP* is the weighted average WTP, and *HHP* is the household population.

The second objective of this study was to assess the potential factors affecting rice farmers' and community members' WTP. Since wetlands are complex ecosystems and render specialized services, managing and establishing sustainable measures demand an integrated approach involving ecology, economics, and sociology [65]. The households' WTP for sustainability of the resources (such as swampy wetlands) that are considered public goods [35] are influenced by several cultural, social, demographic, economic, and psychological factors [66]. Understanding the key demographic factors affecting communities' decisions can help to improve the sustainability of swampy wetlands because population structure, size, and distribution have strong linkages with social and economic development and the management of natural resources. Population growth has an effect on the environment as it leads to expansion of agricultural lands, settlements, and other livelihood activities [67]. The study assumes that the respondents' desire for the sustainability of swampy wetland is a function of WTP, which provides an indicator of the total economic value of natural resources, such as swampy wetlands [68].

In determining the WTP amount of the respondents, several influencing factors were considered and analyzed using logistic regression. According to Mutuli [69], ordinary least squares, tobit, logistic, logit, and probit regression models can be used to examine the factors influencing WTP for environmental goods and services. Oduor et al. [35] and Mwakubo and Obare [70] used tobit regression analysis to show that educational level, farm size, ownership, and household size influence households' likelihood of actively engaging in wetland resource exploitation and their WTP for its conservation. Kong et al. [42] used a logistic model and found that household income, residential location, arable land area, and contracted water area influenced the respondent's WTP levels. In contrast, Adepoju and Salimonu [71] used a logit model and found that age, income, and educational level influenced the propensities to contribute to improved water sources. This model was preferred to other regression models because this study involves continuous and categorical variables. As evidenced by Greene [72], the logistic regression model is considered perfect when dealing with categorical variables. The model conforms to principles of homoscedasticity [73]. It is mostly employed because it fits well and is suitable for describing and testing hypotheses regarding the relationship between dichotomous categorical outcome variables and one or more categorical predictors [74].

This study examined gender, age, household size, income, source of income, farm size, and knowledge about wetlands as the potential determinants of WTP (Table 1). These variables are in line with those widely used by researchers (e.g., [14,35,42,75]) when assessing factors contributing to the WTP for environmental resource conservation. Factors that are found to be significant vary geographically. WTP was therefore estimated as a function of various influencing factors such as gender, age, household size, income, income source, wetland knowledge (education), and farm size.

Table 1. Explanatory variables used in the ordered logistic regression model.

Explanatory Variables	Definition of Variables	Description of Variables
GH	Gender (male) of household head	Dummy variable where male = 1, female = 0
AH	Age of household head	Categorical (dummy variable where ages of 20–30 = 1, 31–40 = 2, 41–50 = 3, 51–60 = 4, >60 = 5; 20–30 is the left-out group)
HS	Household size	Continuous variable
ISH	Income source of household head	Dummy variable where farmers have other income source = 1, no other income source = 0
ALS	Arable land size	Dummy variable where if respondents consider large arable land size affects WTP decision = 1, if no = 0
WKH	Wetland knowledge of household head	Dummy variable where respondent is aware of wetland roles, uses, and benefits = 1, if no = 0
IH	Income of household head	Categorical (dummy variable where <500 USD = 1, 500–1000 USD = 2, 1100–2000 USD = 3, 2100–5000 USD = 4, 5100–10,000 USD = 5; <500 USD is the left-out group)

The following model was used for the logistic regression:

$$y^* \; = \; \beta_0 + \sum_{j\,=\,i}^{k} \beta_j x_{ij} + \varepsilon_i \tag{3}$$

where y^* is the latent variable (dependable variable) that measures the desire or intention/WTP for swampy wetland conservation. The latent variable (y) adopts a dummy variable value of 0 or 1; $\boldsymbol{y}$ is 1 if the respondent's WTP is more than zero and **0** if less than or equal to zero.

$$y \;=\; \left\{ \begin{array}{l} 1\, if\ y^* > 0 \\ 0\, if\ y^* \leq 0 \end{array} \right\} \tag{4}$$

where I_0 is the constant or intercept; I_j is coefficient of the determinants; x_{ij} are the independent variables/determinants (gender, age, household size, income, source of income, farm size, and knowledge); and ε_i is the residual/error term.

The full equation is represented by the following [42]:

$$\begin{array}{c} y^*(WTP) = \; \beta_0 + \beta_1 sex + \beta_2 age + \beta_3 household\ size + \beta_4 disposable\ income \\ +\beta_5 source\ of\ income + \beta_6\ farm\ size + \beta_7 knowledge\ about\ wetland + \varepsilon_i \end{array} \tag{5}$$

The model was nested to test fitness; three models were used and are listed as follows:

Model A (all parameters)

$$y^*(WTP) = \; \beta_0 + \beta_1 x_1 \ldots\ldots\ldots \beta_7 x_7 + \varepsilon_i \tag{6}$$

$$\begin{array}{c} y^*(WTP) = \beta_0 + \beta_1 gender + \beta_2 age + \beta_3 household\ size + \beta_4 disposable\ income + \\ \beta_5 source\ of\ income + \beta_6\ farm\ size + \beta_7 knowledge\ about\ wetland + \varepsilon_i \end{array}$$

Nested Model B

$$y^*(WTP) = \; \beta_0 + \beta_1 x_1 \ldots\ldots\ldots \beta_6 x_6 + \varepsilon_i \tag{7}$$

$$\begin{array}{c} y^*(WTP) = \beta_0 + \beta_1 gender + \beta_2 household\ size + \beta_3 disposable\ income + \\ \beta_4 source\ of\ income + \beta_5\ farm\ size + \beta_6 knowledge\ about\ wetland + \varepsilon_i \end{array}$$

Nested Model C

$$y^*(WTP) = \beta_0 + \beta_1 x_1 \ldots\ldots\ldots \beta_5 x_5 + \varepsilon_i \tag{8}$$

$$\begin{array}{c} y^*(WTP) = \beta_0 + \beta_1 gender + \beta_2 household\ size + \beta_3 disposable\ income + \\ \beta_4\ farm\ size + \beta_5 knowledge\ about\ wetland + \varepsilon_i \end{array}$$

4. Results

4.1. Sociodemographic Characteristics of Respondents

The respondents' sociodemographic information is presented in Table 2. In our sample, 74% were men (accounting for 73% of total farmers and 80% of total community members) and 26% were women (accounting for 27% of total farmers and 20% of total community members). The age ranges of 31–40 years (30.6%) and 41–50 years (33.8%) represent the majority of the respondents, with that of 60 years and above (6.3%) being the smallest (older adults). We found that 65.6% of the respondents had formal education, while 34.4% did not. Most respondents (48.1%) earned 1000 USD or less annually, with 24.4% earning 1100–2000 USD, and a few (11.2%) earning 5100 USD and above (Table 2). The average number of dependents in a household is 9. The results reveal that for 32.5% of the farmers, rice farming is the sole income source, which implies that their livelihood depends on the sustainability of the swampy wetlands, while 33.1% farm additional crops.

Table 2. Sociodemographic characteristics of respondents.

Characteristic	Category	Frequency	Percentage (%)
Gender	Male	119	74.4
	Female	41	25.6
Age (years)	20–30	17	10.6
	31–40	49	30.6
	41–50	54	33.8
	51–60	30	18.8
	>60	10	6.3
Educational level	Primary	24	15.0
	Junior high school	38	23.8
	Senior high school	21	13.1
	Graduate	22	13.8
	No formal education	55	34.4
Income sources	Mainly rice farm	52	32.5
	Other crop farms	53	33.1
	Other job	55	34.4
Income level	$\begin{pmatrix} < 500\ USD \\ 500\text{–}1000\ USD \end{pmatrix} < 1000$ USD	$\begin{pmatrix} 50 \\ 27 \end{pmatrix} 77$	$\begin{pmatrix} 31.2 \\ 16.9 \end{pmatrix} 48.1$
	1100–2000 USD	39	24.4
	2100–5000 USD	26	16.3
	5100–10,000 USD	18	11.2

4.2. Assessment of the Effects of Postharvest Losses on Swampy Wetlands

4.2.1. Type of Land Used for Rice Production and Size of Swampy Wetland Degraded

To find the extent to which rice farming uses swampy areas, respondents were asked to state their rice farm acreages and preferred areas. The answers revealed that 92.5% of the farmers' land under rice in the study area comprises swampy wetlands and only 5% was flatland/upland, whiles 2.5% used both swampy wetland and flatland/upland (Figure 3). Out of the 272.92 hectares of land used by the rice farmers, swampy wetlands constituted 78.46% (214.12 ha) while flatland and upland constituted 21.54% (representing 58.8 ha).

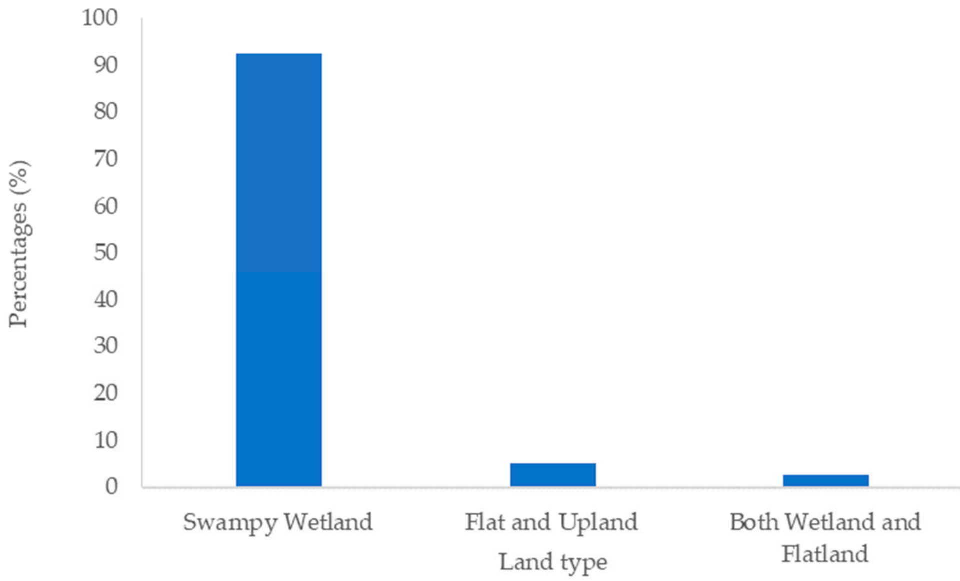

Figure 3. Types of land used for rice production.

4.2.2. Farmers' Reasons for Increasing Swampy Wetland Use

Postharvest losses compelled a majority of the rice farmers to increase the swampy wetlands area used for rice cultivation so that they can earn a higher income and thus be able to sustain their dependents. The data show that 60.8% of the respondents have increased their land size from five years ago to (1) increase income to meet family needs due to crop losses, (2) commercialize rice farming, and (3) meet the increasing demand. About 80.82% of respondents indicated that they mainly increased the land size for a higher income (Figure 4). At nine dependents per farmer household, average high dependency is the main reason for land area increase. Since most of the land used is swampy wetlands, higher land use means smaller free wetlands area. If the situation continues, the wetlands are likely to be incapable of providing ecological services, such as flood control, ecosystem (habitat) for plants and animals, regulation of hydrological flows, storage, and retention of water, etc., which highlights the urgent need for wetlands sustainability.

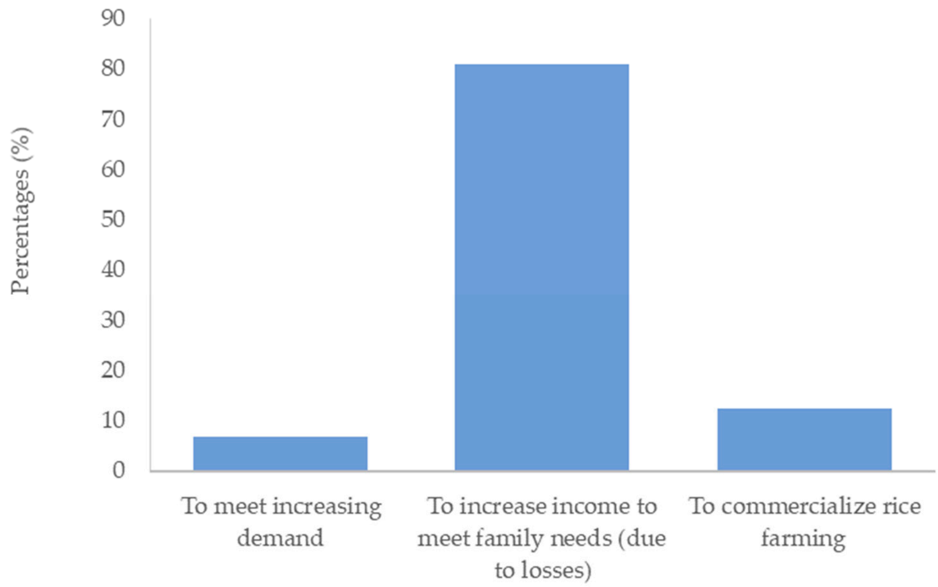

Figure 4. Farmers' reasons for increasing swampy wetland use.

4.3. WTP for Sustainable Use and Conservation of Swampy Wetland

Figure 5 summarizes rice farmers' and community members' WTP for swampy wetland sustainability in the study area: while 89.4% of respondents indicated yes (i.e., willing to pay for wetland sustainability), 10.6% were not willing to pay, asserting that their income was not sufficient to meet the needs of their dependents and that maintenance of swampy wetlands was a government responsibility. However, since the majority (89%) agreed, it demonstrates the importance the farmers attach to wetlands and their understanding of ecological systems' functions and services. The reasonably high literacy rate of the respondents (65.6%) could have contributed to their understanding of the ecosystem and their WTP for conservation (Table 1).

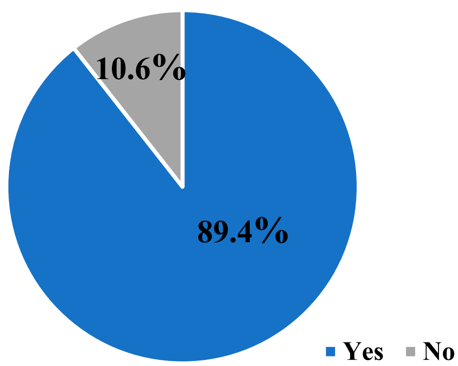

Figure 5. WTP for swampy wetland's sustainable use and conservation.

Table 3 depicts the reported WTP of the various stakeholders and its standard errors. The standard errors of the WTP means are low, indicating low deviations from the true mean (thereby representing the true mean of the population). The mean WTP of the rice farmers (197.04 USD/household/ha/year) was higher than that of the community members (125.27 USD/household/ha/year). This could be because the farmers suffered both direct and indirect impacts from the swampy wetlands compared to the community members, who experienced only the indirect impacts. The respondents are therefore willing to pay 54.90–213.11 USD/household/ha/year. However, taken together, farmers and community members have a mean WTP of 180.17 USD/household/ha/year (Table 3) despite their limited disposable income. This amount represents the annual WTP of rice farmers and community members toward the ecological sustainability of the swampy wetlands. In comparison, farmer households in China were willing to pay an average of 64.39 USD/household for the ecological compensation of wetland areas in 2014 [42], and in Kenya, they were willing to pay 16.7 USD/year [35]. These amounts are lower than that of the study area, indicating the importance these respondents attached to the sustainability of swampy wetlands. This could also be because rice farming, their livelihood, is dependent on the swampy wetlands, and farmers recognize the need for its sustainable use. The households were willing to pay an aggregate 0.298–1.158 USD/year for making swampy wetland sustainable, while the farmers and community members together were willing to offer an aggregated 0.979 USD/year for the sustainable use of swampy wetlands.

Table 3. Rice farmers' and community members' WTP (weighted means).

WTP of Groups/Stakeholders (USD/Household/ha)	n	WTP	Std. Error	Std dev	Min	Max
All rice farmers and community members	143	180.17	1.10	124.47	9.12	456.20
All rice farmers	109	197.04	1.34	132.88	9.12	456.20
All community members	34	125.57	1.23	67.72	22.81	273.72
Ashanti Region rice farmers	52	230.74	1.39	123.74	36.50	456.20
Northern Region rice farmers	57	54.90	1.17	50.66	9.12	182.48
Ashanti Region community members	18	146.91	1.46	67.21	45.62	273.72
Northern Region community members	16	76.43	1.18	35.80	22.81	136.86
Ashanti Region rice farmers and community members	70	213.11	1.19	119.19475	36.50	456.20
Northern Region rice farmers and community members	73	61.96	0.89	47.40	9.12	182.48

Figure 6 shows the frequency of WTP classes, where the class of <500 USD recorded the greatest occurrences and that of 5100–10,000 USD the least.

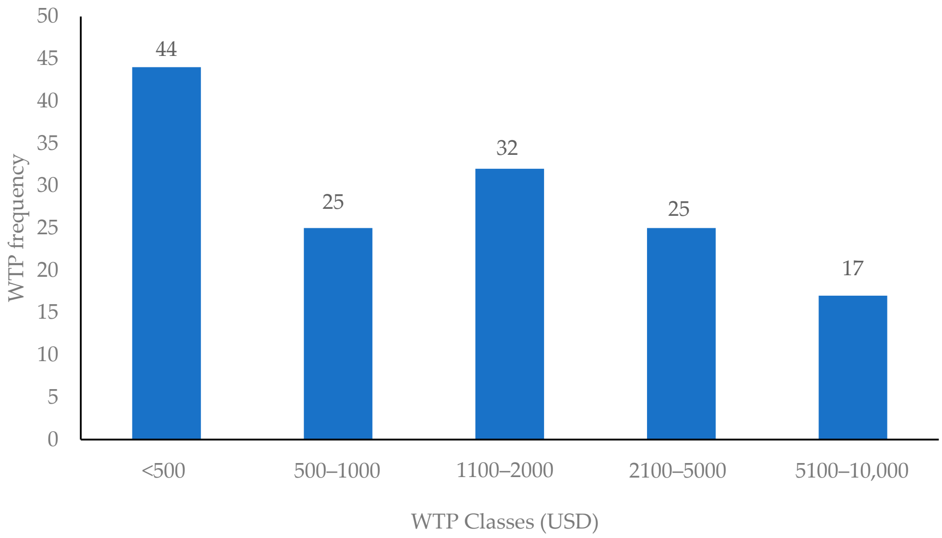

Figure 6. Frequency bar plot of different classes of WTP.

4.4. Determinants of the WTP for Swampy Wetland Conservation

The ordered logistic regression results for WTP predictors of swampy wetland sustainability are shown in Tables 4–6. Table 4 shows model A (with all predictors), Table 5 is a nested model B, and Table 6 is a nested model C (with limited predictors). Model A with all the predictors appears to have a better fit than the nested models do (shown in the tables).

Table 4. Results of ordered logistic regression on determinants of the WTP model A.

WTP	Coeff.	Std. Err	t	$p > t$	95% Conf. Interval	
GH	−2.057221	0.7704232	−2.67	0.008 **	−3.567223	−5472193
HS	−2774474	0.1312002	−2.11	0.034 *	−0202997	−5345952
ISH	−3856584	0.7077381	−0.54	0.586	−1.7728	1.001483
ALSH	−050718	0.6823467	−0.07	0.941	−1.388093	1.286657
WKH	2.793243	0.8228993	3.39	0.001 **	1.18039	4.406096
AH_new2	0.8227511	1.058125	0.78	0.437	−1.251136	2.896638
AH_new3	−2485268	1.054697	−0.24	0.814	−2.315695	1.818642
AH_new4	−1.788222	1.152716	−1.55	0.121	−4.047504	0.4710595
AH_new5	−2.456424	1.596108	−1.54	0.124	−5.584738	0.6718892
IH_new2	−1.057996	0.9824037	−1.08	0.282	−2.983472	0.8674799
IH_new3	−2.258338	1.08728	−2.08	0.038*	−4.389367	−1273085
IH_new4	−1036002	0.9916653	−0.10	0.917	−2.047228	1.840028
IH_new5	0.6722404	1.495099	0.45	0.653	−2.2581	3.602581
_cons	3.033772	1.494095	2.03	0.042	0.1053988	5.962145
Number of obs.	160					
LR chi2	28.29					
Prob > chi2	0.0082					
Log Likelihood	−37.867997					
Pseudo R2	0.2720					

Note: * and ** denote significance at the 5% and 1% levels, respectively.

Table 5. Results of ordered logistic regression on determinants of the WTP nested model B.

WTP	Coeff.	Std. Err	z	$p > \lvert z \rvert$	95% Conf. Interval
GH	−1.337855	0.641841	−2.08	0.037	−2.59584 to −0.0798699
HS	0.1256963	0.0952228	1.32	0.187	−0.060937 to 0.3123295
ISH	−0.2076186	0.6486109	−0.32	0.749	−1.478873 to 1.063635
ALSH	−0.1218091	0.6121863	−0.20	0.842	−1.321672 to 1.078054
WKH	2.233148	0.7035524	3.17	0.002	0.854211 to 3.612086
IH_new2	−1.086006	0.8981415	−1.21	0.227	−2.846331 to 0.6743186
IH_new3	−2.130798	1.015058	−2.10	0.036	−4.120276 to −0.1413204
IH_new4	−0.1335096	0.9429555	−0.14	0.887	−1.981668 to 1.714649
IH_new5	−0.3163948	1.327994	−0.24	0.812	−2.919216 to 2.286427
_cons	2.866088	1.368711	2.09	0.036	0.1834639 to 5.548712
Number of obs.	160				
LR chi2	21.06				
Prob > chi2	0.0124				
Log Likelihood	−41.482145				
Pseudo R2	0.2025				

Gender (male), household size, wetland knowledge (education), and income (IH) category 3 (1100–2000 USD) of model A were the significant predictors of WTP at 1%, 5%, 1%, and 5%, respectively. Income (IH) category 3 (1100–2000 USD) indicates that respondent households with this income level are willing to pay for swampy wetlands sustainability (Figure 7). This could be because most of the respondents with knowledge of wetland ecosystems fall within this income category (representing 32.1%, as seen in Figure 7) and that their income is linked to the sustainability of swampy wetlands. They have a higher WTP since they have more knowledge about the functions, services, and importance of wetland ecosystems than the respondents in other income categories.

Table 6. Results of ordered logistic regression on determinants of the WTP nested model C.

WTP	Coeff.	Std. Err	z	$p > \|z\|$	[95% Conf. Interval]
GH	−1.357308	0.6396698	−2.12	0.034	−2.611037 to −0.1035781
HS	0.1238556	0.0947688	1.31	0.191	−0.0618879 to 0.3095991
ALSH	−0.1661746	0.5964772	−0.28	0.781	−1.335249 to 1.002899
WKH	2.207216	0.6979194	3.16	0.002	0.8393192 to 3.575113
IH_new2	−1.106059	0.8928604	−1.24	0.215	−2.856033 to 0.6439154
IH_new3	−2.142427	1.014037	−2.11	0.035	−4.129902 to −0.1549512
IH_new4	−0.1582033	0.9397089	−0.17	0.866	−1.999999 to 1.683592
IH_new5	−0.34458	1.326647	−0.26	0.795	−2.94476 to 2.2556
_cons	2.814874	1.355823	2.08	0.038	0.1575093 to 5.472238
Number of obs.	160				
LR chi2	20.96				
Prob > chi2	0.00734				
Log Likelihood	−41.534062				
Pseudo R2	0.2015				

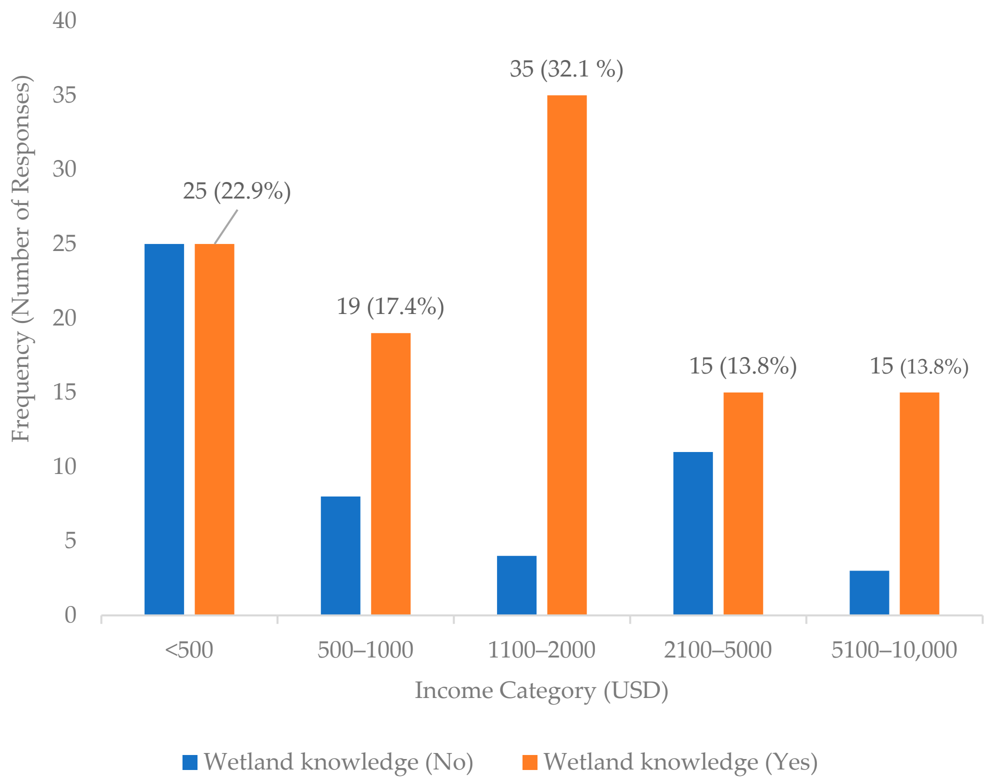

Figure 7. Income categories and knowledge about wetland ecosystems.

The pseudo R-squared value of 0.2720 signifies that the model appears to be a good fit ($p < 0.0082$), with the variables of gender, household size, wetland knowledge, and IH Category 3 as predictors with significant ordered odd-log estimates. According to McFadden, pseudo R-squared values between 0.2 to 0.4 represent an excellent fit [76]. Siew et al. [14] similarly found a pseudo R-squared value of 0.39, which suggests a low but good model fit, given the significant predictors.

5. Discussion

The sociodemographic information of the respondents indicates that males outnumber females in rice production. The respondents explained that this is because the women were more engaged in processing (postharvest activities) and marketing the produce than in direct production. This finding is in line with the FAO study that found women to be more into food processing activities and sales [77]. This can also be attributed to the patriarchal nature of the study area, where men are typically the heads of households [78] who own land (land ownership) and lead farming activities. The domination of men in the sample could also be due to the hard labor-intensive nature of rice production. The age distribution indicates that the study area has a comparatively young population. The age group of 20–50 years covers 73.4% of the respondents and constitutes the working population. This also suggests that the rice industry, as well as agriculture, sustains a large workforce [79] and is a national economic asset.

The finding of 89% of the respondents' desire for swampy wetland sustainability demonstrates the importance they attach to the resources and their understanding of ecological systems' functioning and services. The literacy rate (65.6%) likely contributed to their understanding of swampy wetland ecosystems and their WTP. Education as a proxy for information flow holds the potential to reduce the many characteristics of swampy wetland users that might act as impediments to sustainable use and conservation of the resource. Such impediments include users' fear of change, imperviousness to new ideas, and lack of motivation [35]. Education is a form of human capital and contributes to achieving good allocation of resources [80]. The mean WTP of rice farmers (197.04 USD /household/ha/year) was higher than that of community members (125.27 USD/household/ha/year). This may be because farmers are affected both directly and indirectly by the swampy wetlands, while community members are only affected indirectly.

In sum, the WTP of the rice farmers and community members was influenced by sociodemographic factors such as gender (male), household size, knowledge about wetlands (education), and income. Gender (male) shows a negative correlation with WTP based on the ordered log-odd estimate. The ordered logit for males is less than that for females by 2.057 when the other variables are constant. The reason why the WTP for swampy wetland sustainability of male-headed rice-farming households is less than that of female-headed ones is because male household heads tend to be concerned more with increasing their income to take care of their dependents [80] and feel disinclined to pay a higher amount for sustainability. Further, since women in rural communities in developing countries are the primary users and stewards of natural ecosystems, their WTP is likely to be higher [81].

Household size influences WTP and is negatively correlated. If a household increases its size by a unit point, the expected WTP outcome is reduced by 0.277, with all other variables held constant. This indicates that a smaller household size increases the WTP for sustainable swampy wetlands. Assuming that income is constant, an increase in household size reduces farmers' ability to meet their subsistence needs, especially when postharvest losses are high, and this may subsequently lead to an increase in the land size for rice cultivation. Thus, the high dependency ratio requires extra income to support subsistence requirements and hence brings down the WTP. This result is consistent with many similar studies. For example, Bamire et al. [82] found that increased household size may suggest an increased consumption level, which is associated with increased land usage and thus exposes the land area to further degradation.

The ordered log-odd estimate for wetland knowledge (education) on the expected WTP outcome shows that a unit point increase in wetland knowledge would lead to a marginal increase in the WTP outcome by 0.001. This observation can be attributed to 65.6% of the respondents having a formal education. Education brings more knowledge and helps people better understand contemporary considerations [83].

Income Category 3 (1100–2000 USD) was found to be significantly linked with WTP; the WTP outcome is expected to increase by 0.038 if IH increases by a unit point, with all other variables remaining constant. This indicates that respondent households with this income level have a higher WTP to sustain swampy wetlands.

Several studies have explored the factors contributing to wetland ecosystem conservation. For example, Oduor et al. [35] found sex, age, household size, and education to be significant factors, while Kong et al. [42] identified income, location of residence, arable land area, and contracted water area as significant factors. The relevance of these influencing factors is further confirmed by this study, with some exceptions related to geographical location, since WTP is location-specific.

6. Conclusions

This study assessed rice farmers' and community members' WTP to ensure sustainable utilization of swampy wetlands in Ghana's Northern and Ashanti Regions; we analyzed its predictors by calculating the WTP by the CVM and ordered logistic regression. The study was based on a sample of 160 participants from four districts, selected due to their exposure to postharvest losses, inadequate irrigation facilities, and overreliance on rainfall for agriculture, which are the contributing factors to the expansion of swampy wetlands under rice production [13,24]. These have caused ecological damage to the swampy wetland ecosystem, thus preventing it from performing its ecological services. The findings revealed that swampy wetlands are fundamental to the livelihoods of rice farmers in the study regions, as 65.6% of them depend on swampy wetlands for agricultural production. The rice farmers were, therefore, willing to pay 0.298–1.158 million USD per household, with an average of 0.979 million USD annually, to ensure the sustainable use of swampy wetlands in their districts. The gender (male) of the household head, household size, household disposable income, and knowledge about the importance of wetlands were the predictors of their WTP. The study concluded that rice farmers and the community showed a positive response to the sustainable use of swampy wetlands.

7. Recommendations

Policymakers are likely to appreciate the findings of this study, which show the importance rice farmers and community members attach to swampy wetlands and of the sociodemographics. The novel findings revealed areas that policymakers can focus on in implementing programs and policies to stop wetland degradation.

Based on the outcome of the study, we recommend a policy review to target wetland sustainability and sustainable livelihoods for farmers in the following areas. First, rice production is a key area that policymakers can focus on, through educating farmers and the public on the importance, functions, and sustainability of swampy wetlands and natural wetland ecosystems, since education is a contributing factor in farmers' WTP. Second, regular family planning sensitization programs should be conducted for farmers to reduce household size. This may contribute to the sustainability of swampy wetlands since household size influences WTP. Agreeing with Kyarisiima et al. [84], we hold that larger households create unsustainable conditions for wetland sustainability. Third, adequate irrigation facilities should be constructed, since irrigation in the country only covers 16% of the land under rice cultivation [19]. This is likely to help meet the water demands from rice farmers and reduce the pressure on swampy wetlands in the rice-growing areas. Fourth, more women should be encouraged to go into the rice industry since they show a higher WTP for swampy wetland sustainability than men do. Lastly, adequate postharvest facilities must be ensured to reduce postharvest losses, which is a known contributing factor to the expansion of swampy wetlands for farming (i.e., increasing land usage to offset losses) [24]. The provision of such facilities, coupled with the stakeholders' willingness to sustain swampy wetlands, is expected to be significant for the attainment of sustainable use of swampy wetlands.

8. Limitations

The main limitation is the small size of the sample. Future studies should focus on other rice-growing regions with a larger sample size to overcome this limitation. This would improve and clearly define the stakeholders' WTP in a larger context and represent the WTP of stakeholders throughout Ghana as well. Further, in the study, it was not possible to explore all other factors that could account for the respondents' WTP.

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Institutional Review Board Statement: The study was conducted according to the guidelines of the Declaration of Helsinki, and approved by the Institutional Ethics Committee of University of Tsukuba (protocol code 2019-1 and date of approval 31 July 2019).

Informed Consent Statement: Informed consent was obtained from all subjects involved in the study.

Data Availability Statement: Data sharing is not applicable to this article. This is because one of the conditions for receiving responses from the survey respondents was that the data obtained from the survey would be used only for this study.

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