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Willingness to Pay for Improved Water Quality and Influencing factors: An Insight from Chia Lagoon, Malawi

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Abstract: (1) Background: Water resources at Chia lagoon experience possible threat to its sustainability. Communities are seeking alternatives to improve water quality at the lagoon. The study evaluated the extent at which local communities are WTP to improve water quality at Chia lagoon and the influencing factors. (2) Methods: A study was conducted at Chia lagoon, Western Part of Lake Malawi from November, 2015 to March, 2016. Wide range of data collection approaches such as household surveys, exploratory surveys, focus group discussions, key informant interviews and field observation were employed. A sample of 240 households were selected randomly. Qualitative data was analysed using content analysis. Multivariate logistic regression analysis was used to determine factors influence WTP. (3) Results: Out of 240 respondents, 57.4% expressed WTP. Multivariate logistic regression analysis demonstrated significant ($P<0.01$ or $P<0.05$) relationship between demographic (Gender, age, literacy level), social-economic (Land ownership, main agriculture water source and income) and institution (civic education and social network, extension, water user rights) factors and WTP. **(**4) Conclusion: The findings from this study provide significant clues for further research and baseline information for local government and local communities in development of more effective and holistic approaches to improve water quality.

Key words: Chia lagoon, Water resources, willingness to pay (WTP), Malawi

1. Introduction

Water resources in the natural ecosystems is a vital global economic resource [1].Malawi is amongst the countries in the world endowed with a variety of fresh water systems [2]. The water systems in Malawi include Lake Malawi, Lake Malombe, Shire River which forms part of African great rift valleys, Lake Chilwa, Chia lagoon and several networks of river systems [3] Although, Malawi is known to have variety of water systems, it is documented as a water-stressed country and projected to be water scarce by 2025 if nothing is done to mitigate the impending crises [4-5]. Water resources at Chia lagoon provide the best illustration. With no clear defined policy and management plan to protect the resources, the lagoon has been overstressed from pollution, siltation and weed invasion. Again, the impact of climate change such as upward trend of extreme weather related events has further stressed the resources at the lagoon [6] as evidenced by Warnatzsch and Rea, [7] and Malawi government report which further projected that by 2025, water resources in Malawi will be scarce [4]. Limuwa et al. [8] also noted that climate change poses a serious threat to Malawi economy as it significantly affect water resources especially in Western Part of Lake Malawi. The government of Malawi through various legal frameworks has taken various measures to safeguard and protect water resources in the country and this include, the enactment of the Environmental

Management Act of 2017 [9]; the Forestry Policy of 1997[10]; the Land Policy of 2002 [11] and the Water and Sanitation Policy of 2006 [12] and the National Water Policy (2005) [13]. However, most of these government legal frameworks attach the important role of managing the resource to the state overlooking the significance of stimulating public participation in the management of the resources [14]. Again, much of the studies on water resources management have also overlooked the significance of evaluating the extent at which the local communities are willingness to pay towards the improvement of water resources in the natural ecosystems and the factors influencing WTP. Due to lack of such studies, most of the decision have been top down approach [15]. The consequences have been lack of public participation in the watershed management [16]. Chia lagoon provide the best example. Most important rivers that empty into Chia lagoon have significantly degraded and the lagoon is currently stressed with heavy siltation and water quality deterioration [17]. Economic theory explains that individuals have preferences [18]. Their preferences are linked to the willingness to pay (WTP). However, there are several factors linked to household's WTP. Therefore, this paper theorized key factors linked to communities WTP towards conservation of water resources at Chia lagoon. Identifying these key factors can enhance better policy formulation and appropriate intervention in the management of water resources at the lagoon. The sections of this paper were framed as follows: Section 2 provides a conceptual framework, section 3 describes data collection procedures and research methods, and section 4 illustrates study results, section 5 illustrates and deduce the practical discussion and section 6 provide a brief summary of the research and provides policy suggestions and recommendations.

2. Conceptual framework

This study was designed based on the theory of community perception [19]. The perception study was initially developed during Ogallala Aquifer region of Great Western United States [19]. In Malawi, Limuwa et al. [8] adopted the same approach to evaluate small scale fishers' perception on climate change and their coping strategies. In this study, perception of the communities was linked to the principles of economics. Economic principles explain that individuals have preferences and choose according to those preferences. It is very apparent that little is presently known about local communities WTP to improve water quality at Chia lagoon. About 2.5% of population in the Western Part of Lake Malawi are found in Chia lagoon catchment (8). This study was designed to understand the attitude of local communities towards their WTP for improving water quality. We chose local communities proximity to the lagoon as they could be the one contributing to water quality degradation in the lagoon while at the same time are the ones subjected to serious economic and health risks in the area. The objective of this study was to theorize potential factors affecting communities for their WTP. In a public resources such as water resources, the willingness to pay of a household towards conservation of the resources depend on several factors amongst being cultural, social, demographic, economic and psychological factors. It is presumed that critical understanding of these factors can help to formulate appropriate policy that respond to the needs of the public. However, these require application of advanced econometric techniques which lead to the development and application of Bernoulli regression model, a group of statistical models emanating from conditional Bernoulli distributions. Thus, multivariate logistic regression model to analyze factors affecting willingness-to-pay was applied. According to Greene [20], multivariate logistic regression model is considered to be a perfect model when dealing with categorical value. The model conforms to principles of homoscedasticity [21]. The model is further mostly preferred due to the fact that it is well fitted and suitable for describing and testing hypotheses about relationship between dichotomous categorical outcome variable and one or more categorical predictor [22].

3. Data collection procedures and research methods

3.1 Study area

The study was conducted at Chia lagoon which lies between latitudes 13°0' and 13°30'S, and longitudes 33°50' and 42°20'E of Western Part of Lake Malawi. The area has estimated population of 404,102 which is 2.3% of approximately 17million Malawi population and receives average annual rainfall ranges from 860 to1600mm between December and March and average temperatures of 32°C. Chia lagoon is the largest lagoon in Malawi with approximately watershed area of 989km^2 [17]. The lagoon is fed by Lifuliza, Likoa and Bambara Rivers which originate from the Ntchisi hills through deeply incised gorges and valleys before winding through the lowland plains and entering the lagoon [17]. Chia lagoon watershed has vast natural resources vital to over 55,000 human inhabitants. The uplands are characterized by *Brachystegia julbernadia* savannah and woodland. The lagoon's fringes are heavily colonized by marsh reeds (*Phragmites spp*.) and shrubs that thrive under waterlogged conditions (e.g. *Aeschynomene, Mimosa* and *Sesbania spp* [17].

3.2 Data collection protocol

This study adopted mixed research approaches. About six reconnaissance surveys in different villages within the study area were conducted from October, 2015 to November, 2015. These surveys targeted environmental conservation groups, local leaders, fishers and farmers. In order to capture the general perception of water resources at the lagoon, men and women were interviewed separately. The interview was deliberated by asking the households to describe the changes of water quality at the lagoon for the past decades. The responses gathered from the exploratory surveys helped to identify critical issues and also to frame quantitative survey questionnaires [23]. The survey was carried out by highly trained and qualified graduate students from University of Malawi to ensure high quality data.

After reconnaissance survey, semi-structured and structured household questionnaires (Supplementary File 1) and checklist were framed, pretested and checked for internal validity and reliability. The questionnaire was administered to 240 households. The villages for the interviews were sampled purposively based on their proximity to the lagoon. The critical aspect covered in the questionnaire included household composition, demographic and socio-economic characteristics of the household, perception of household towards climate change and ecosystem changes and coping mechanisms [8]. The data collection techniques followed high ethical values [24]. Checklist was used to collect information from focus group discussion. Themes regarding the water resources situation at Chia lagoon were deliberated during the focus group discussion. Eight focus group discussions comprising an average of 12 to 20 members were coordinated by one research assistant. Questions were presented as guideline using three approaches such as resource mapping, institutional analysis and cause-effect analysis [25]. To ensure maximum involvements and full ingenuousness of each individual group, respondents were split in respective to gender and age. FDGs were used to generate the deeper understanding of the past and present situation of water resources at Chia lagoon.

Checklist was developed to provide guideline during key informant interviews. Key informants such as chiefs, local leaders, conservation groups and elderly residents were interviewed to explain their experience regarding water resources situation at Chia lagoon. A 'snowball' technique was employed in selection of each key informant and locate one or two other possible informants through networks [26]. The snowball sampling techniques works in such a way that key informants are obtained from each informant and the sample size grow with subsequent interview until the sample size becomes saturated. Direct observation was also conducted to generate rich data set and also depict the situation of water resources at Chia lagoon, observe livelihoods activities, social networks, and governance issues. The idea behind the direct observation was to try to understand the reason why people behave the way they do. Direct observation was

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done by frequently visiting the communities for an extended period of one month to observe and inquire about their culture, social networks, attitude, governance issues and social economic activities and try to link them to economic theories to understand the economic value they attach to the resources.

3.3 Statistical analysis

Qualitative data generated from focus group discussion, exploratory surveys, direct observation and key informant interviews were decrypted and analysed using critical discourse and content analysis. The techniques helped to isolate main themes from the study and relate them to the objectives of the research questions [25]. On the other hand, data obtained from household survey were analysed using descriptive statistics such as mean, range, frequencies and percentages [27]. The descriptive statistics were employed to critically isolate main characteristics of the respondents. IBM SPSS version 20 was used to analyze the data. Non parametric tests such as Chi-square were applied for demographic, socio-economic and institutional factors. Multivariate logistic regression was used to assess the relationship between respondents demographic, social-economic and institutional factors and their WTP. The regression analysis was coded as 0 or 1 while one indicate the outcome of interest and 0 mean interest is absent.

3.3.1 Logistic regression model

$$\gamma_i = \ln\left(\frac{P}{1-P}\right) = \beta_0 + \beta_1 X_1 + \beta_2\beta_2 + \beta_3\beta_3 + \cdots \beta_n X_n$$

Where P as dependent variable of probability 1, the parameter β_0 is constant and estimates (β_n) is the regression coefficient and X_n is the influencing factors of WTP. Chi-Square Goodness of Fit was used to relate the observed sample distribution with the predictable probability distribution. The idea behind was to define how well hypothetical distribution fit the observed distribution. The $\hat{\gamma}_i$ was assumed to be equal to 1 or 0 and the corresponding model was expressed as

$$\hat{\gamma}_i = \frac{exp(\alpha + \beta_1 X_{i1} + \cdots + \beta_k X_{ik})}{1 + exp(\alpha + \beta_1 X_{i1} + \cdots + \beta_k X_{ik})}$$

The homogeneous residual in the model was defined as

$$r_i = \frac{\gamma_{i-\hat{\gamma}_i}}{\sqrt{\hat{\gamma}_{i(1-\hat{\gamma}_i)}}} \text{ Or } X^2 = \sum_{i=1}^{n} {r_i}^2$$

It is important to note that X^2 distribution has n-(k+1) degrees of freedom, so that p-values can be calculated. Hosmer-Lemeshow test was used to examine whether the experimental proportions of events were similar to the forecasted probabilities of occurrence in subgroups of the model population. The test was performed by dividing the predicted probabilities into deciles and then computing a Pearson Chi-square that compares the predicted to the observed frequencies. The value of Hosmer-Lemeshow test was

$$H = \sum_{g=1}^{10} \frac{(O_g - E_g)^2}{E_g}$$

Where O_g and E_g denote the observed events and expected events for the g^{th} risk decile group. The test statistics asymptotically follows x^2 distribution with g (number of groups-2) degrees of freedom. The test statistic asymptotically follows a $\chi 2$ distribution with *8* (number of groups -2) degrees of freedom. The likelihood-ratio test was used to asses an overall model fit. It was used to assess the contribution of an individual predictors to a given model. The test compared the likelihood of obtaining the data when the

parameter is zero (L_0) with the likelihood (L_1) of obtaining the data evaluated at the MLE of the parameters. The test was expressed as

$$G = -2\ln\frac{L_0}{L_1} = -2(\ln L_0 - \ln L_1)$$

The Wald statistic was used to assess the contribution of individual predictors. The Wald statistics was expressed as the ratio of the square of the regression coefficient to the square of the standard error of the coefficient. The Wald statistics was asymptotically expressed as

$$.W_j = \frac{\beta_j^2}{SE_{\beta j}^2}$$

4 Results

4.1 Characteristics of the respondents

The study targeted a total of 300 households. However, 240 questionnaires were administered representing 80% of valid response rate. It was noted that about 52% of these respondents were above 40 years old. Similar results have been reported elsewhere in Ghana with age distribution within the range of 41-50 years old. The study further reported 51% male respondents than female 49%. Kopa [28] had similar observation in a study conducted in Nkhotakota, Central Malawi whereby it was reported that 73% of the respondents were male. It was further interesting to note that 75% of the respondents were married, with other 25% being single, widowed, divorced or separated. About 51% had a family size of above 4. The literacy level was 49% meaning that about 51% of the respondents could not read nor write. Conversely, Malawi demographic and health survey [9] and World Bank reports indicate slightly higher literacy level (69.7%) in Nkhotakota district [9] and 62% in Malawi [29] than what the study reported at Chia lagoon. The study further found that the majority (58.4%) of the respondents depend on the lagoon as a main source of water for agricultural activities. On the other hand, 47.5% depend on water resources from the lagoon for generating their income through fishing, informal business, farming and other socio-economic activities. Evidently, 52.5% of the respondents own fishing craft, 52.9% own land around the lagoon, 50.5% have access to grazing land, 52.5% engage in farming activities, 53.5% conduct various businesses around the lagoon and 49.5% practice irrigation using the water from the lagoon. Again 55.4% of the respondents have access to food gathering from the lagoon. However, in terms of annual income level, the study revealed that 43% of the respondents have annual income level above US$252.84. The study further revealed some of the major challenges for water resources conservation at the lagoon. Results from quantitative analysis revealed that majority of the households (61%) lost trust in the existing natural resources conservation committees. On the contrary, the study revealed that the majority (67%) of the households believed that government is capable of implementing water resources conservation program at the lagoon. The study further revealed that the majority (53.2%) of the respondents had poor access to water resources conservation civic education and social networking despite the majority (65.3%) being aware of the problem of water resources degradation and depletion at the lagoon.

4.2 Analysis of factors influencing WTP

Demographic, socio-economic and institutional factors were tested for multicollinearity before introducing them into a logit model (Supplementary File 2). The results showed that multicollinearity was not a problem. None of the explanatory variables were strongly correlated or overlapped suggesting that the

explanatory variables were fit to be presented in the logit model. Table 1, 2 and 3 show the logit estimates of the probability of the respondents' WTP.

Table 1: Effects for the best fitted logistic regression model of demographic variables

Parameters	β	S. E	Wald	Sig
Constant	-2.62	0.82	10.25	0.00**
GH	-1.19	0.71	2.81	0.02*
AGH	-2.77	0.85	10.63	0.00**
CS	-0.15	0.75	0.04	0.85 ns
LL	2.31	0.83	7.52	0.01 *
HS	-1.15	0.71	2.66	0.10 ns

Hosmer and Lemeshow test, Chi- square=5.44 (df=8), P=0.71 -2log likelihood =59.1%, Note: Nagelkerke R Square=0.73 Cox & Snell R Square=0.54

Note: ns indicates not significant while ** and * indicate significance at 0.01 and 0.05 probability level of Confidence

Note: GH=gender, AGH= age, CS=civil status, LL=literacy level, HS=household size

Table 2: Effects for the best fitted logistic regression model of socio economic variables

Parameters	β	S. E	Wald	Sig
Constant	3.28	0.35	6.51	0.01*
LMSWA	5.35	0.70	7.43	0.01*
LOS	-1.93	0.82	5.61	0.02*
FLP	1.12	0.12	0.04	0.85ns
PIF	0.45	0.28	0.12	0.72ns
AFG	1.65	0.29	1.63	0.06ns
DBLP	0.42	0.64	2.67	0.08ns
HALI	1.63	0.28	5.12	0.02*

Hosmer and Lemeshow test, Chi- square=8.55(df=8), P=0.38 -2log likelihood =137.78 Note: Nagelkerke R Square=0.86 Cox & Snell R Square=0.64

Note: ns indicates not significant while ** and * indicate significance at 0.01 and 0.05 probability level of confidence

LMSWA= Lagoon main source of water for agriculture, LOS=Land ownership, FLP=Farm in the lagoon periphery, PIF=Practice irrigation farming using water from the lagoon, AFGLW =Access to food gathering from lagoon waters, DBLP= Does business in the lagoon periphery, HALI=Household annual level of income

Table 3: Effects for the best fitted logistic regression model of demographic variables

PARAMETERS	B	S.E.	Wald	Sig.
CONSTANT	-2.98	1.17	6.51	0.01**
HST	1.21	0.80	2.31	0.13ns
WRCCESNI	0.83	0.85	6.97	0.02*
IT	0.74	0.76	0.95	0.33ns
KWDD	0.28	0.88	0.10	0.06ns
AEXTS	2.47	0.83	8.83	0.00**
KKWRUR	0.80	0.82	1.53	0.02*
AIIWRM	1.52	0.75	4.10	0.043ns

Hosmer and Lemeshow test, Chi-square= 5.12, (df=8), P=0.75 -2log likelihood =50.64 Cox & Snell R Square=0.58, Note: Nagelkerke R Square=0.78

Note: ns indicates not significant while ** and * indicate significance at 0.01 and 0.05 probability level of confidence

***ST**= Household 'social trust, **WRCCESNI**= Water Resources Conservation Civic education and social networking involvement, **AEFS**= Access to external financial support, **IT**= Institution trust, **KWDD**= Knowledge of water resources degradation and depletion, **AEXTS**= Access to extension services, **KWRUR**= Knowledge on water resources user rights, **AIIWRM**= Access to information on IWRM*

According to principles of econometrics, R-squared values are expected to be constrained to the range of 0-1 (0-100%), with higher values indicating the better model fit [30]. In this case, the Cox and Snell (1989)

were used to test the model's power of prediction. However, a modified Cox and Snell was also used to allow R-squared to take on values in the full range of zero to one, making pseudo –R-squared more compatible to a conventional R-squared statistic. Table 1 showed Cox and Snell (1989) R-squared (0.54) and Nagelkerke (1991) R-squared (0.73) statistics. Hosmer and Lemeshow (1989) Chi-square value was 5.44 and non-significance ($p>0.05$). Table 2 on the other hand showed that Cox and Snell, (1989) R-squared was 0.64 (64%) and modified Nagelkerke, (1991) R-squared was 0.86 (86%). Hosmer and Lemeshow Chi-square value was 8.55 and non-significance ($p>0.05$). Table 3 showed Cox and Snell (1989) R-squared (equals to 0.58) and Nagelkerke (1991) R-squared (equals to 0.78) statistics. Hosmer and Lemeshow (1989) Chi-square value was 5.12 and non-significance ($p>0.05$). The overall analysis indicate that multivariate regression model explained a substantial amount of variance in the choice of the respondents' WTP. Hosmer and Lemeshow, (1989) goodness of fit test was greater than 0.05 and non-significant at 0.05 indicating that the models were reasonably a good fit to the data and, therefore, good overall model fit. Multivariate logistic regression was conducted to determine if demographic, socio-economic and institutional factors are associated with local communities' attitude of WTP. As shown in Table 1, 2, 3, these demographic (Gender, age, literacy level), social-economic (Land ownership, main agriculture water source and income) and institution (civic education and social network, extension, water user rights) factors had a significant effect on WTP.

4. Discussion

Water quality degradation in major natural ecosystems has dominated public concern in Malawi. For instance, during the qualitative interviews, some households expressed the following experiences: "*...In early around 1970s, Chia lagoon had a clear water throughout the year, however, in recent times, the quality of water in the lagoon has severely deteriorated....*'' A synthesis of exploratory secondary data extracted from relevant documents such as books, publications, journal articles and reports indicated that changes in water quality in natural ecosystems such as lagoons and wetlands is attributed to both anthropogenic activities and climate change. Several examples have been demonstrated by different authors. For instance, Land use/land cover, climate, soil physical-chemical properties, geology of land, topography and spatial patterns of interaction are among the hydrological processes in watersheds can lead to wetlands and ecosystem degradation [31]. In Kenya, Muriuki et al. [32] noted that rapid population growth, deforestation, diminishing land holdngs, erratic rainfall patterns and conflict in water use are among significant factors influence watershed degradation which lead to loss of wetlands in some areas, increasing water pollution and decrease in water levels which in turn affected the aquatic ecosystem negatively. In Ethiopia, Wolka et al.[33] oberved that increased flooding and newly formed rills and gullies in watershed resulted into loss of Cheleka wetland. In Rwanda, the anthropogenic actvities in the watershed resulted into degradation of Rugez Marsh [34]. In Malawi, Banderson, et al. [35] noted that Chia lagoon has seriously experienced water quality degradation because of agricultural activities, irrigation development, climate change, drought and other human activities.

Our field observation established that prolonged turbidity, siltation of the lagoon and increase in invasive alien species were major indicators of water quality degradation. It was noted that opening new land for agriculture, cultivation on steep slopes and stream banks, poor farming practices, felling of trees for wood, and setting bush fires which destroy or degrade valuable vegetative cover significantly contributed to the serious problems of water runoff and loss of top soil, especially in the upper reaches of the watershed leading into sedimentation of Chia lagoon which negatively affected the lagoon's rich biodiversity [35]. We noted that there is a major concern among government, NGOs and local communities on the current state of water quality. The local communities have strong intention to improve the water quality. We linked communities' intention to the notion of neoclassical economic principles [36]. The interests of local communities to improve water quality was equated to their WTP. Moldan, [37] observed that insufficient availability of water to meet all demands, including minimum environmental flow requirements has significant impact on the household's WTP. Multivariate logistic regression analysis shown in Table 1, 2

and 3 demonstrated significant (P<0.01 or P<0.05) relationship between demographic (Gender, age, literacy level), social-economic (Land ownership, main agriculture water source and income) and institution (civic education and social network, extension, water user rights) factors and WTP. We found that demographic variables such as age of the household head was negative with a correlation regression coefficient of -2.77 and Wald of 10.63 and statistically significant at $\alpha = 0.05$ while the relationship between dependent variable and level of literacy was positive with a correlation regression coefficient of 2.31, Wald of 7.52 and statistically significant at $\alpha = 0.05$. Hypothetically, age was expected to be negative as older respondents' participation in water resources conservation program at the lagoon was expected to be lower than the young respondents. However, our findings conform to what Mezgebo and Ewnetu, [38] found in Mutale Local Municipality, South Africa which showed that the respondents of age above 50 years were less willing to pay more for improved water services in the short term. On the contrary, Harun et al. [39] in a study done in Iraq found that older people were willing to pay more for water irrigation than the young farmers. Again, we found that education is widely considered to be the most important form of human capital [31] and can significantly influence communities WTP. Our findings from the study were in line with hypothetical expectations. Hypothetically, the coefficient of literacy level was anticipated to be positive as respondents who were literate were expected to be more conversant with economic values derived from the water resources at the lagoon and were likely to be more willing to pay than the respondents who were not literate. Our findings agreed with Kanyoka et al. [40] who found that level of education had an influence on WTP in South Africa.

Social-economic variable between main source of water for agriculture **(LMSWA)** and WTP had positive relationship**.** Regression model was significant at $\alpha = 0.05$ and had coefficient of 2.35 and Wald of 11.43. Similarly, a positive relationship between the probability of the respondents was noted in level of income (LI) and WTP`. Regression coefficient was 3.06, Wald of 17.80 and was statistically significant at $\alpha = 0.01$. On contrary, relationship between the probability of the respondents 'WTP and land ownership was negative. Regression coefficient was -1.93, Wald of 5.61 and was statistically significant at $\alpha = 0.05$. Johnson et al, [41] reported that the decisions on how to manage water resources in the lagoon could be based on the location of land used for agricultural production or settlements. Again, Leeworthy and Bowker, [42] summarized linkages between the economy and the environment. The model explained that the actual conditions relating to quality and quantity of water resources in wetlands are important factors determining the individual's perception towards the conservation. This explains that the level of demand of water resources economic value in terms of agriculture significantly influence the individual's perception towards the value of the lagoon. Arouna and Dabbert, [43] showed a positive correlation between the level of income and WTP for water supply improvement in Benin. Similar results were also reported by Mezgebo and Ewnetu [38] in Nebelet town, Ethiopia.

Institution factors such as water resources conservation civic education and social networking involvement (WRCCESNI) and access to extension services (AEXT) and Knowledge on water resources user rights (**KWRUR**) were statistically significant at $\alpha = 0.01$. We found that households who had access to water resources conservation civic education through conservation agriculture programs were more WTP in order to conserve water resources at the lagoon. Similarly, the households who were more connected to social networks such as electronic media and were easily convinced to pay towards the program. The study findings concurs with Agudelo [44] who observed that as the demand for water resources increases to their availability, the communities are more willing to pay towards the conservation program to sustain the resources. Faraji and Mirdamadi [45] had similar observation among the apple producers in the Damavand area. Other authors also previously mentioned that extension service play a critical role in facilitating linkages between the communities and other relevant sectors such as government departments, private sectors, non-governmental organization, research institutes and education centers[46]. Similar observation was made by Mbo'o-Tchouawou and Colverson [47] in rural population in Kenya.

Kapanda et al [48] reported that lack of extension staff was an important adoption problem. Paris, [49] further observed that the success and failure of improved integrated crop-animal technology depended on availability of information related to social economic impacts of such interventions on rural communities. Nwankwoala [50] argued that the challenges posed by degradation of wetlands could be better understood by the communities if they are proper equipped through awareness for them to understand the economic value attached to the resource.

In our study, we found that out of 240 respondents, 57.4% expressed WTP for better water quality at the lagoon. This study findings indicated high rate of WTP as compared to other previous studies. For instance, Liu et al. [51] reported 53% rate of WTP for improved air quality in China. In New Zealand, Omwenga, [52] reported 25.8% in CV case studies. Barnnet et al [53] on the hand achieved the response rate of 47.3% in Australia. These findings revealed disputed approaches among local communities on water quality improvement from different groups. The finding from this study strongly suggest that different approaches need to be taken for different groups in terms of water quality control and management at Chia lagoon.

5. Conclusion and recommendation

In the study, we found that 57.6% of 240 households are WTP. In additional to this, multivariate logistic regression analysis demonstrated significant ($P<0.01$ or $P<0.05$) relationship between demographic (Gender, age, literacy level), social-economic (Land ownership, main agriculture water source and income) and institution (civic education and social network, extension, water user rights) factors and WTP. This study findings provide a critical insight of WTP from different groups of local communities at Chia lagoon and can be replicated to other local communities. The study again motivates further in-depth future research with a large sample size from various natural ecosystems in Malawi. The new information generated from this study is critical for local government, non-governmental organization and local communities in the development and designing of practical policy and strategy to achieve sustainable water resources management in various natural ecosystems in Malawi.

6. Limitation

This study was designed based on the economic theory. The questionnaire was framed following CVM. However, the questionnaire did not focus on asking exact amount of money the participants were WTP. Furthermore, the study did not estimate the exact amount of money the participants were WTP. Again, the study failed to capture total economic value of Chia lagoon natural ecosystem. Finally, the study only focused Chia lagoon natural ecosystem and the local community's proximity to the lagoon. Therefore, it is very imperative that future research should take into consideration the limitations highlighted above. For instance, research focusing on investigating how much respondents would like to pay and estimation of total economic value of the natural ecosystem is very crucial for policy makers.

Supplementary Materials: The following materials are available online at……File S1: Household survey questionnaire, File S2: Correlation coefficient of factors affecting the WTP.

Author Contribution: Rodgers Makwinja designed the research, collected data, analysed and developed the manuscript. Ishmael. B.M. Kosamu and Chikumbusko Kaonga were involved significantly at each stage of the manuscript writing, field scoping and reviewing the study tools.

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Declaring conflict of interest: The authors declare that there is no conflict of interest.

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