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Research article

Community perception to pay for conservation of Barekese and Owabi watersheds in Ghana

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ABSTRACT

There is growing concern globally to conserve natural systems including watersheds due to increasing forest degradation and deforestation. The Barekese and Owabi watersheds provide several ecosystem services to communities, health facilities and industries. The watersheds are found in a rapidly degrading environment due to increasing anthropogenic activities. This paper addressed the neglected, but critical, question of the importance of watershed ecosystem services. The objective of the study was to determine willingness of households in downstream communities to pay for watershed conservation and the drivers of WTP. Households were willing to pay a mean of $1.5 ± 0.2 additional on their monthly water bills. Quotations for Willingness to pay varied from as low as $0.02 to as high as $ 20.58 per month. Age, household size and years of residence were significantly related with willingness to pay, amount to pay and reasons for protest bids. The younger generations and women were ready to pay extra amount for watershed management. The results indicated that downstream communities are willing to support conservation and that demographic factors influence the amount people are willing to pay. The concept of WTP is useful and applicable to conservation of watersheds in the tropics through the design and implementation of PES schemes. It also provides important information for conservation and development policies related to watershed management in developing countries.

1. Introduction

Ecosystem services (ES) are the benefits generated from ecosystems to maintain the earth's life support system [1–3]. These services include provisioning services, regulating services, supporting services and cultural services [1–3]. The concept of ES pinpoints the importance of nature in delivering ESs for human welfare and socio-economic growth [4–8]. Yet, over the past decades, the services that these systems generate have been significantly degraded [6,7,9,10]. These days, ecosystem services are typically used to link a broad range of environmental indicators for management and policy, as well as to better appreciate the importance of the environment [9]. The ES which culminated in the groundbreaking UN Millennium Ecosystem Assessment (MEA), has been accepted as a term for research in the academic community that may link science with practice and policy in a way that persuasively advocates for immediate environmental action [10]. The concept of ES has over the years gained substantial consideration in global environmental policies [1,2,4,6,7,10,11,12]. Over the years, the concept has gained traction in policy instruments relating to nature conservation and environmental management [4,13–15].

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Watersheds are a highly productive, multifunctional, and valuable ecosystem that provides a complex array of goods and services [12,16] and diverse and enormous benefits to society [16]. These services include food, timber, medicines, water purification, habitat maintenance for terrestrial and aquatic species, flood control and microclimate, among several others [17–20]. The focus of watershed management has evolved from the hydrological cycle and the management of water resources to the current integrated approach of managing biological, physical, and social aspects in a landscape within a watershed [6,7,21]. Watersheds are the optimum units for managing not only water resources, but also ecosystems in general, according to a growing global consensus [22]. Many countries are now attempting to integrate watershed management into natural and human systems [23,24]. Watershed management acknowledges that the interaction of water with other resources has an impact on humans and that humans can influence the nature and scale of those interactions. However, poor watershed management over years have led to decline in ES including water quality [25,16,20,26,27] due to forest degradation and deforestation which affect forest structure and function [19,28]. These challenges stem from conversion of riparian vegetation to agricultural lands, settlements, urbanization, among others.

The Barekese and Owabi watersheds in Ghana have a diversity of resources including pristine forest, high biodiversity, wetlands and other features that support favourable climate conditions. The watersheds are important source of ecosystem goods and services including freshwater, beautiful sceneries, timber, food production, carbon sequestration, among others. The watersheds are the main source of water for domestic and industrial purpose for more than one million people in the Atwima Nwabiagya District and Kumasi Metropolitan Assembly Though these ecosystems are important locally and globally, yet there are under enormous pressure from various drivers of forest degradation and deforestation particularly from various competing demands like agriculture and human settlement expansion [29–31]. The Atwima Nwabiagya is one of the fastest growing Districts in Ghana, which means that urban sprawl and other land-use changes may substantially affect ESs including those provided by the Barekese and Owabi watersheds. Over the past three decades, the annual settlement expansion rate has been 33% in the Owabi watershed, while the Barekese watershed's cropland has expanded at a rate of about 5% per annum [31]. This has contributed extensively to forest degradation and deterioration in the water resources in the past three decades leading to a decrease in ESs. Therefore, further degradation could have negative impact on ecosystem condition and, consequently, their capacity to meet the demand of the growing socio-economic development rates in the region. Such effects, however, are difficult to quantify and have seldom been considered in the decision-making process and management of the watersheds [32,33].

There are various ways in which can be measured as the social demand for ESs, stakeholders value and demand [16,34]. Ecosystems can be investigated at several scales, including the global, regional, and local. Researchers recommend evaluating the services at the local level, which gives a better grasp of the problem and allows the implementation of appropriate mitigation techniques at the regional level and contribute to achieving global sustainable goals [35,36]. Although recent research investigations by a diverse variety of researchers have provided light on the interdependence of multiple ecosystem services, the merger of existing knowledge reservoir and gaps is still insufficient [20,36]. A variety of scientific and applied viewpoints, including hydrology, remote sensing, biology, geography. management, and restoration have been conducted in watersheds [37,38]. As a result, information about the structure and function of watersheds is spread throughout many domains and disciplines [36,37]. Several research have shown the importance of watersheds for provision of certain ES; however, few have attempted to understand the willingness of beneficiaries to financially support the conservation of forest and watersheds [25,39,40]. Taking note of ecosystems and the benefits generated may be considered an initial step, however, assessment of ES value further in financial terms is seen as important in decision-making and, therefore, promote its mainstreaming [41,42]. An important step forward is thus to translate existing knowledge into a more easily available and immediately applicable overview for decision-making and management of riparian vegetation, which is what this article does.

Willingness to pay for ESs is fast emerging as a logical approach existing to facilitate rational conservation planning [43,44]. Appreciating, accounting for, and articulating the value of ES in a monetary unit is critical to establishing an innovative policy pathway, notably in ecosystem conservation and management [41]. Furthermore, valuing nature is required for the implementation of a market-oriented mechanism including PES, to compensate for conservation efforts and stimulate the increased flow of ESs [45]. It is widely acknowledged in literature that not all ESs are traded in conventional markets, resulting in complexity in assigning monetary units [32,46]. However, there are appropriate nonmarket valuation approaches used to value to ESs. These approaches comprise of stated preference (conjoint valuation, contingent valuation method (CVM), Choice experiment method) and revealed preference (hedonic pricing method, time cost method, and travel cost method) [32,47]. Within the context of neoclassical economics, a monetary unit representing passive, or nonuse values is established and assessed using willingness to pay (WTP) [48]. Despite significant flaws, stated preference is the most widely used valuation approach for assigning monetary value to in tangible benefits [48–51]. The CVM is relatively simple in its application because explicit linkages between non-marketed goods and market prices is not needed [32,48]. It is based on a theoretical state and presenting them to the respondents, then elicit highest willingness to pay required ES indirectly [32,52]. Several watersheds presently provide ESs with both commercial and non-market importance including protection from floods, soil erosion, among others [4]. Recent studies found that WTP for water services by downstream communities offered useful insights for planning and implementation of prospective PES programmes, that may enhance present watershed conservation while also assisting upstream land holders by offering economic possibilities [4,48,53,54].

However, in most developing countries, the determination of WTP in areas where people are reliant on nature including forests and water resources is inadequate [4,55,56]. However, before implementing a PES as a policy choice, a greater knowledge of the perception of interest groups is essential [57]. This is applicable in the situation of Ghana, where PES arrangements for watershed services is gaining policy consideration as a way of encouraging sustainable management of watersheds [20,39]. The current study was carried out in the Barekese and Owabi watersheds in the Ashanti region of Ghana, where PES mechanisms have a high likelihood for hydrological services. Despite the recognized importance of ESs and watershed management, the specific assessment of WTP for improved ESs from these watersheds remains underexplored.

The purpose of this study was to fill this gap by investigating local users' perspectives and demographic factors influencing WTP. The article, advances understanding of WTP for improvement of ESs from forested watersheds. The study provides empirical evidence of local users' perspectives to identify and investigate the WTP of the downstream beneficiaries of drinking water ES offered by the Barekese and Owabi watersheds because of protection by upstream communities. In this analysis, the demographic and socio-economic demographic characteristics that influence WTP for ESs were also examined.

2. Methodology

2.1. Study area

The Barekese and Owabi watersheds are found in the Atwima Nwabiagya District Assembly in Ahanti region of Ghana (Fig. 1). The Owabi and Barekese watersheds are located within longitude 6°44′50"N and latitude 1o 421 00 W (Fig. 1) [31]. The Owabi and Barekese watersheds cover total area of 5767.25 ha and 16,741.53 ha respectively. The vegetation type is typically Moist Semi-deciduous forest type. The Owabi watershed is Wetland 1%, Closed Forest 8.2%, Open Forest 19.8%, Cropland 23.4%, Grassland 9.1% whiles for Barekese watershed Wetland 1.1%, Closed Forest 16.5%, Open Forest 16.7%, Cropland 52.5%, Grassland 8.8%, Settlement 5.6%, and Settlement 39.6% [31]. The area experiences an annual temperature of between 24.6°C and 27.8 °C and rainfall of about 1402 mm per annum [31,58]. The Owabi watershed is largely peri-urban whiles the Barekese is found in a mostly rural setting. Portions of the Owabi watershed is designated as a Wildlife Sanctuary and is the only inland RMASAR site in Ghana. This makes the Owabi watershed an important wetland ecosystem for migratory birds. The two sites generally have gentle terrain in terms of topography that is good for crop agriculture. It is characteristically located near major cities, where human population densities are high [59]. There are massive anthropogenic activities in the watershed which has resulted in decline in water quality and low aquatic biodiversity [31,60]. Although the two watersheds are considered major source of water supply for the second largest City in Ghana., it is particularly vulnerable to forest degradation and deforestation resulting in high rates of evapotranspiration. The Barekese and Owabi watershed is at the centre of serious conflict over land use. The watersheds are made up of dams: Barekese dam constructed in 1972 and Owabi dam became operational in 1920 through an Executive Instrument which are impoundment that provide serve

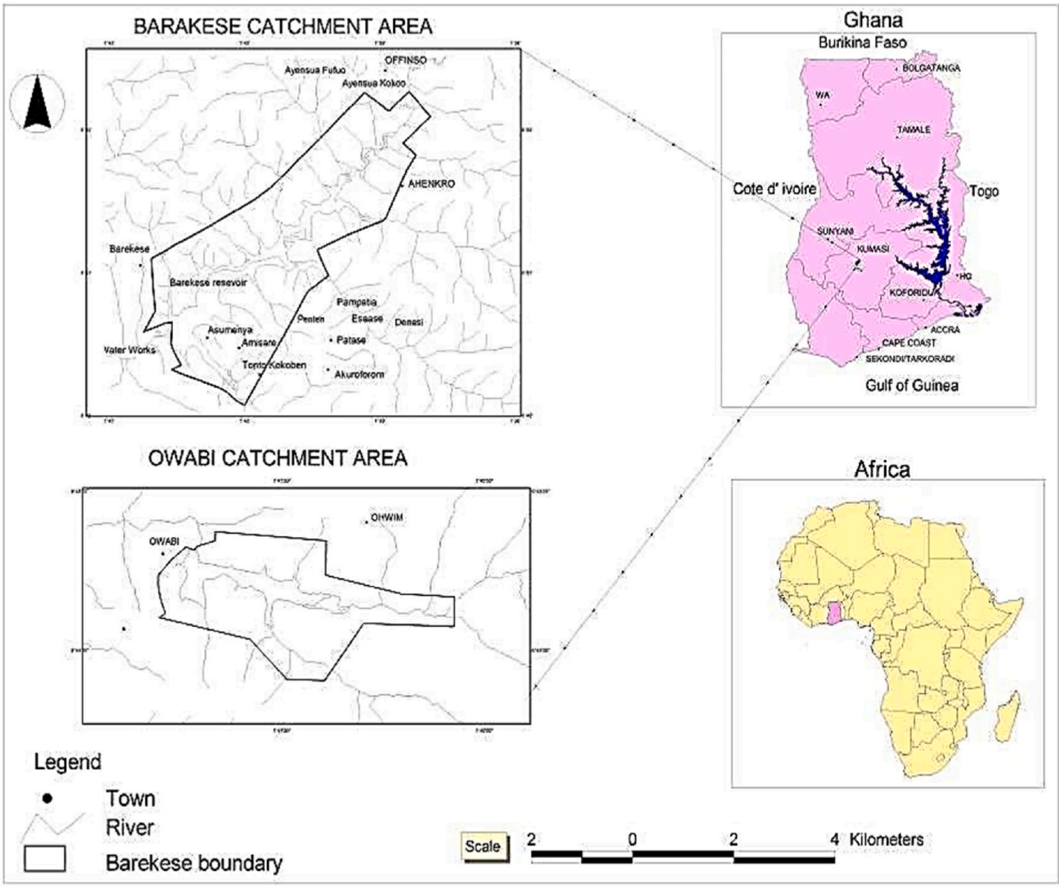

Fig. 1. Location map of the study area.

downstream communities. Together the two reservoirs supply water to over one million people in the Kumasi Metropolitan Assemble and Atwima Nwabiagya District Assembly. Water volumes in these reservoirs is predicted to reduce in the near future because of increased siltation and increased deforestation from increase in human population [60]. The watersheds provide critical ES including water purification, drinking water, microclimate, habitat services which are under threat from anthropogenic activities.

2.2. Survey design

The study was conducted using the Contingent Valuation Method which a state preference method. It is the optimum method used in the estimation of in tangible values of ecosystem services as well as the bundle of services simultaneously [39,61,62]. Because the CVM has been widely employed in environmental analysis, the stated preference approach and CVM have become increasingly popular, due to its ease of implementation and applicability to a wide range of value categories, particularly the non-use type [25, 63–65].

The CVM technique requests respondents to directly indicate their Willingness To Pay (WTP) for the provision or improvement in a service. The study was conducted using the open ended (OE) format to elicit information from the respondent on ecosystem services. The main instrument for data collection was a questionnaire. The survey instrument was developed based on discussions with experts from Ghana Water Company Limited, Wildlife Division and opinion leaders in some of the catchment communities. Pre-testing of questionnaire was be done in a community not selected for the main questionnaire surveys. The rationale was to identify any unanticipated problems with question wording, instructions, ease of answering or skipping questions that will affect the output. It was also intended to help find out if the interviewees understood the questions and could give useful answers. The pre-testing of questionnaires helped to improve questionnaire development and design. A total of 390 households were randomly sampled with 30 households per community interviewed. The overall sample size for the survey was approximately 390 households using [66] formula developed to calculate a representative sample:

$$n_o = \frac{z^2 pq}{e^2} \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots$$

where, no is the sample size, z the critical value of desired confidence level, p (p = 0.5) estimated proportion of the attribute present in the population, q = 1-p (1–0.5 = 0.5) and desired level of precision taking 95% confidence level with ±5% precision (0.05). Hence, required sample size was as follows:

$$\mathrm{p} = 0.5, \mathrm{q} = 1 - 0.5 = 0.5, \mathrm{e} = 0.05, \mathrm{z} = 1.96$$

$$n_o = \frac{(1.96)^2 (0.5)(0.5)}{(0.05)^2} = 384.14$$

Thirteen (13) communities were selected from both downstream communities for the survey. These communities were randomly selected from a pool of communities that depend on the watersheds for water resources. The thirteen communities were Adankwame, Barekese, Maaban, Nkwantakese, Achiase, Aboabo, Esaase, Bokankye, Atafoa, Ohwim, Asuofia. Patasi and Abuakwa.

During face-to-face interviews, respondents answered questions on the demographics, willingness to pay additional amount on water bills to support watershed protection and how much households are willing to pay in Ghana cedis. This approach is a reliable way in CVM investigations for emerging nations compared with other methods like mailed questionnaire and telephone surveys [39, 40,61]. Using this approach, those administering the questionnaires can readily relate with interviewees and explain any uncertainties to reduce non-response rates, and thereby improve the quality of data collected. The respondents were about their monthly WTP for improvement in water and other environmental services. Respondents were presented with an assumed condition of improvement in water quantity and quality at an extra cost and situation another where it reduced without making a further payment. This scenario was intended to motivate the respondent to reflect on the WTP question.

The administration of the questionnaires for the sampled population were randomly done to give everyone in the population the opportunity or chance to be interviewed to ensure that it was representative. The willingness to pay was elicited from a selected households from downstream communities dependent on the watershed. The communities were selected based discussions with the Forestry Commission and Ghana Water Company Limited to identify communities that benefit from the watershed. This information was complemented with published literature. A single-bound dichotomous choice design was used to elicit willingness to pay based on yes or no question. Data on household socio-demographic characteristics expected to have a relationship with WTP was also collected. These characteristics were sex, education, age, household size, years of residence, knowledge of dam, among others. All responses were examined as much as feasible, a protest is when a respondent believes it is not "their" function to preserve, as it is the obligation of government or an inadequate confidence in existing institutions responsible for the conservation programmes. Respondent Individuals who did appreciate the idea were omitted from participating in the survey.

2.3. Data analysis

Microsoft Excel and IBM SPSS (Statistical Package for the Social Sciences) software version 20 were used to analyze responses in the questionnaires. The MS Excel spreadsheet and then was imported into SPSS software for descriptive and inferential statistical analysis. The IBM SPSS Statistics is a software package used for the analysis of statistical data. The mean, total, minimum, and maximum values were calculated for the WTP. The Chi Square test was to determine the relationship of between household WTP for resource conservation and various demographic as well as environmental factors. Significance of the relationship between the variables was tested at 0.05 level at 95% confidence. The Chi Square test was used for the analysis because the demographic data were categorical in nature and therefore parametric test like regression analysis could not be applied in this case.

3. Results

3.1. Socio-demographic characteristics

A large percentage (68%) of the respondents were below 50 years (Table 1). Among the age classes, those 37–47 years were highest (28%) whiles the older than generation (70–80yrs) were the least (1%). The males (52.8%) were more than the females. Majority of the people had basic education (16.9%) whiles a few people had primary (2.3%) or no formal education (2.3%). A considerable number of the respondent have had tertiary education. Many of the people were unemployed. Among the those employed, the main occupation of the inhabitants was skilled labour (mainly artisanal) with a sizable number working in Government Institutions (7.3%). Most households were between to 4–6 people (48%) with a few of the household comprising 10 or more people (7.4%). Most people have stayed in the communities for more than 6 years (77%). Over the 86% were aware that the watershed was the main source of water supply for the community and objective for establishing the Barekese and Owabi dams. Others thought that the dam within the watershed was constructed to mainly promote tourism (10%).

3.2. Willing to pay

Majority of the people (53.9%) indicated their readiness to pay an additional levy on monthly water bills to support the protection of the watersheds (Fig. 2) whiles 46.1% of the people interviewed were not prepared to pay additional money tailored towards watershed conservation. However, in some communities a greater proportion (63.3%) were willing to pay. Based on scenarios for improvement on watershed protection and management on the average indicated their willingness to pay an additional GH₵7.3 ± 0.8 (($1.5) on monthly water bills. This figure is significant given that minimum wage for Ghana is 14.88. Quotations for Willingness to pay varied from as low as GH₵0.10 to as high as GH₵ 100.00. Mean value for Barekese of GH₵9.1 ± 1.5 was higher than that ofGH ₵5.9 ± 0.7 for Owabi (Table 2). Among the communities surveyed, willingness to pay for watershed conservation was highest in Adankwame, Nkwantakese and Ohwim. Achiase and Abuakwa communities proposed the least amounts of GH₵3.9 and GH₵4.3. Respondents indicated level of certainty regarding the amount people are willing to pay water bills. Most of the people interviewed were either very certain (53.4 %) or certain (28.2%) about paying the amount suggested (Fig. 3). A few people were not who willingness to financially support the conservation of the two watersheds through selection of Certain (1.9%) and Very certain (3.4%).

Table 1
Socio-demographic characteristics of the respondents from selected communities in the Barekese and Owabi watersheds.

Parameter	Category	Frequency	Percent
Age class	15–25	75	19.2
	26–36	80	20.5
	37–47	111	28.5
	48–58	83	21.3
	59–69	36	9.2
	70–80	5	1.3
Sex	Male	206	52.8
	Female	184	47.2
Occupation	Government	42	10.8
	Skilled	93	23.8
	Farming	30	7.7
	Others	225	57.7
Education	Primary	9	2.3
	JHS	66	16.9
	SHS	51	13.1
	Tertiary	24	6.2
	Uneducated	9	2.3
Household size	1–3	75	19.2
	4–6	188	48.2
	7–9	97	24.9
	10 and above	29	7.4
Years of residence	1–3	51	13.1
	4–6	40	10.3
	6–10	80	20.5
	11 and above	219	56.2
Knowledge of dam	Gold mining Area	2	0.5
	Wildlife Area	10	2.6
	Tourist Attraction	39	10.0
	Water Source	337	86.4

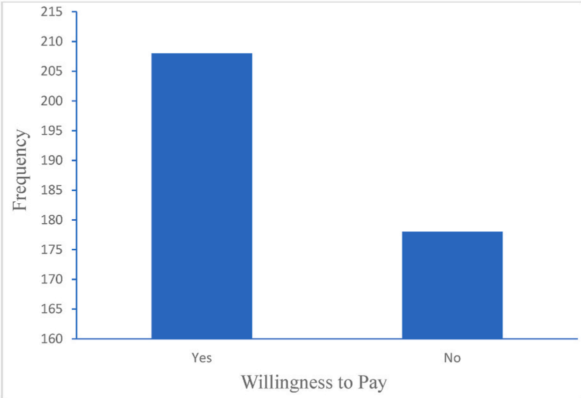

Fig. 2. Respondent willingness to pay additional on monthly water bill for Owabi and Barekese Watershed conservation.

Table 2
Household Willingness to Pay for ecosystem service provision at Owabi and Barekese watersheds.

Site	Communities	#	Mean (GH₵)	SE	Min. (GH₵)	Max. (GH₵)
Barekese	Adankwame	30	16.5	6.5	1	100
Mean	Barekese	30	8.6	3.5	1	50
	Maaban	30	6.9	1.4	1	20
	Nkwanta kese	30	11.3	3.6	0.1	50
	Achiase	30	3.9	0.7	2	10
	Aboabo	30	5.3	0.6	2	10
			9.1	**1.5**	**0.1**	**100**
Owabi	Esaase	30	5.3	0.9	1	15
Mean	Bokankye	30	5.3	2.5	1	20
	Atafoa	30	6.5	2.7	1	50
	Ohwim	30	7.9	2.7	1	50
	Asuofia	30	6.3	1.4	1	20
	Patasi	30	5.8	1.3	1	30
	Abuakwa	30	4.3	0.6	1	10
		30	**5.9**	**0.7**	**1**	**50**
Overall mean			**7.3**	**0.8**	**0.1**	**100**

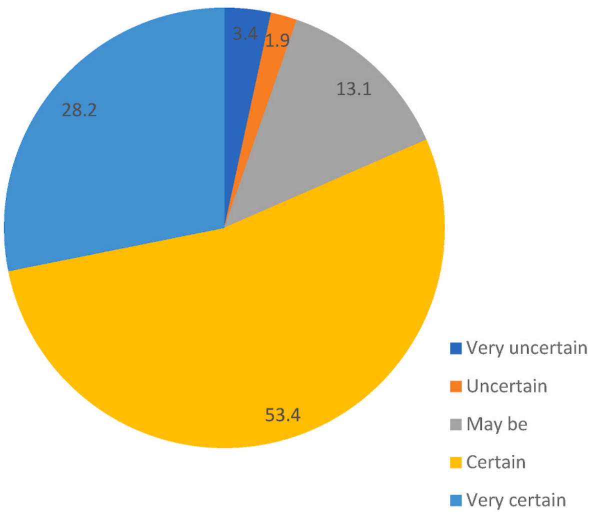

Fig. 3. Level of certainty associated with willingness to pay additional on monthly. water bill for Owabi and Barekese Watershed conservation.

About 13% of the respondent were not sure about paying the suggested amount. Among those not ready pay any additional money on water bills to support conservation of the two watersheds indicated the major reason for the decision was that respondents could not afford (49.1%). Other respondents assigned reasons such as "Don't Care (2.9%)", Not responsible for problem (6.9 %), Wise use of funds not guaranteed (33.7%) and Others (7.4%) (Fig. 4). Among the age classes sampled, majority of the younger Age groups were willing to pay more on the monthly water bills compared the older age classes (≥59 years) (Fig. 5). Females were ready higher amounts compared to their male counterparts to support conservation of the Barekese and Owabi watersheds (Fig. 6). It was estimated that the aggregated total WTP per month to be GH₵ 737,767.20 ($151.596.00) and for a year GH₵8,853,206.40 ($1,819,152.00) based on the figure of 100,000 households provided by the Ghana Water Company Limited.

3.3. *Demographic and management factors that influence willingness to pay*

A chi square analysis of the factors that may influence the community willingness to pay showed that a few factors influenced peoples' willingness to pay or otherwise (Table 3). Regarding people's willingness to pay additional on water bill, the Age, household size and year of residence showed a strong relationship. On the issue of amount to pay, the age, occupation and household size of the people was a major influence. In the case of those not willing to pay, the age, community the person resides in and the catchment where the community is located play a major role. Other factors such as Gender, Threat facing dam, Source of water, Water quality concerns, Water supply problems and Management challenges did not show significant relationship with peoples' willingness to pay or otherwise. Age class of the people interviewed had a strong association with Willing to pay, Amount to pay and not willing pay.

4. Discussion

This study has extended the application of contingent valuation of local watershed in Ghana. It shows that households in local communities in Ghana are willing to pay to support watershed conservation The findings from the Barekese and Owabi watershed indicate household support for PES programmes to improve and sustain benefits from the watersheds. The 44% of protest WTP bid was higher than the 20–25% observed in other studies but considered acceptable for developing countries where WTP is at the rudimentary stage of implementation [[67],[40],[39],[68]]. Most watersheds occur in rural or peri-urban areas which are usually remote from downstream beneficiaries found largely urban centre. These beneficiaries in these remote areas in some cases do not appreciate the likelihood and consequences of watershed degradation and the urgent need to contribute financially towards conservation efforts tailored to ensure the sustainable supply of ES.

From the perspective of decision-makers two measures: the mean and median are used for describing the dispersal of WTP and these may have various interpretations. When a decision is to be based on an efficiency criterion, it is mean then that is considered a better measure [69]. The mean monthly WTP per household of GH₵7.3 ± 0.8 ($1.5) with a 95% confidence interval of GH₵ 5.92–8.87 is significant representing half of the minimum wage for Ghana of 14.88 ($3.06). Most of the household are largely dependent on the watershed for water for domestic and industrial purposes [70] and therefore WTP signifies strong preference by the downstream communities for outcomes that lead to enhancement in water quality and supply. In view of this, beneficiaries of the services are motivated to contribute to the conservation of the watershed to ensure continuous supply of ES. The idea of Ess and natural capital are gradually becoming persuasive means to demonstrate, quantify and value the extent of linkages between humans and nature. The estimated WTP reflect the site's contribution to economic development in the region, that needs to be considered, by policy makers and resource managers as well as local communities. The approach provides economic information critical in the planning of watershed conservation at a time when competing demands have been growing steadily.

When compared to other studies in Ghana, the mean monthly WTP per household of GH₵7.3 ± 0.8 ($1.5 ± 0.02) is higher than the WTP of $0.75 for improved rainwater provision in the savanna zone [62], but lower than the WTP of $2.8 [39] and US$ 2.22 [25] for the conservation of Atewa Range Forest, as well as $4.6 for preservation of the Weija dam [40] in Ghana. Furthermore, the WTP

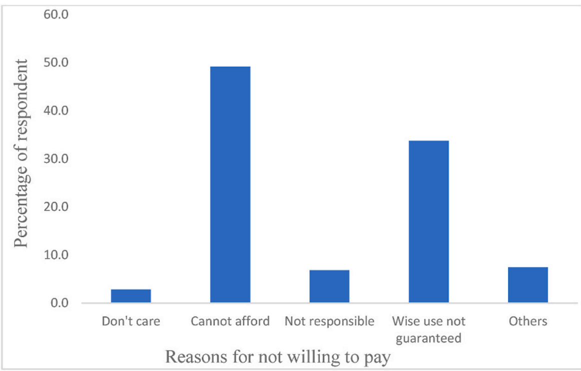

Fig. 4. Reasons respondent unwillingness to pay additional on monthly water bill for Owabi and Barekese Watershed conservation.

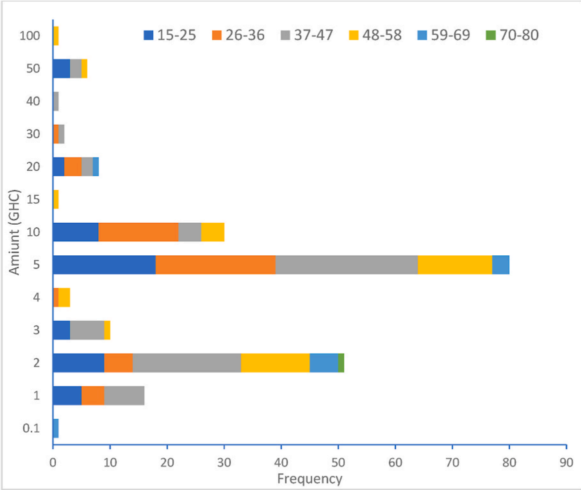

Fig. 5. Household Willing-To-Pay per age groups of the respondents.

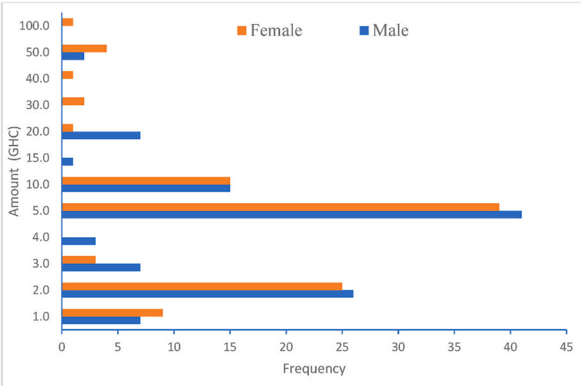

Fig. 6. Household Willing-To-Pay according to gender of the respondents.

Table 3
The relationship between willingness to pay and various demographic and management factors.

Variable	Willing to pay additional		Amount to pay		Reason for not willing pay	
	χ2	P-value	χ2	P-value	χ2	P-value
Age	21.294	**0.001**[a]	82.329	**0.029**[a]	53.137	**0.000**[a]
Gender	0.36	0.85	15.804	0.2	3.206	0.524
Occupation	6.211	0.102	66.494	**0.001**[a]	14.721	0.257
Household size	9.824	**0.044**[a]	53.385	**0.031**[a]	21.175	0.172
Community	20.928	0.051	141.468	0.544	97.447	**0.000**[a]
Years of residence	12.024	**0.007**[a]	38.59	0.353	11.42	0.493
Catchment	1.708	0.191	10.325	0.587	19.7	**0.001**[a]
Threat facing dam	2.419	0.789	63.249	0.362	22.278	0.134
Source of water	5.365	0.147	16.946	0.997	19.171	0.084
Water quality concerns	10.761	0.096	55.904	0.919	24.336	0.082
Water supply problems	5.837	0.322	33.666	0.942	11.276	0.792
Management challenges	8.409	0.078	20.401	0.944	17.396	0.135

[a] Significant at 0.05 level.

estimate for this study is generally lower than WTP recorded in other studies from other countries like Kenya of USD 7.4 ± 0.3, USD 9.1 ± 0.5, and USD11.1 ± 0.7 for the cultural, bequest and biodiversity conservation services accordingly for lgeyo the Watershed Ecosystem, WTP of US$ 13.15 for visiting the Mont Buffalo national park [71] in Australia, US$ 7.89 for of inland development impact on environment in marine parks in Malaysia [72] and for a Ramsar site in Massa, Morocco [73]. 20 also recorded a WTP for improvement in water quality between USD 3.94 and USD 6.80/household/month for forest watershed in Arizona. Likewise, others reported higher estimate of WTP of USD 2.52–6.43/household/month for enhanced water quality by implementation of silvo-pastural system in Florida [55], mean household WTP of US$ 4.89/month for a proposed reforestation to improve water quality in Flagstaff, Arizona [74]. Similarly, other studies also recorded a mean willingness to pay (WTP) of $50/person/month for geothermal energy usage in house heating to improve air quality and reduce the impact of climate change in Turkey [75]. The WTP estimates for the various studies exhibit wide differences variations WTP could be attributed to differences in time of study, target groups and income variations in the sites surveyed in the different studies. While the current study targeted downstream communities most of which are in peri-urban, in the two other previous studies the respondents were largely located in urban areas. The variation in WTP among these studies may also stem from variation in income levels of households in the different countries and places.

Perhaps the significance of the mean WTP becomes clearer when it is aggregated per month and annum based on the estimated total households (100,000 households) provided by the Ghana Water Company Limited as those formally dependent on the Owabi and Barekese watersheds for pipe-borne water. The projected amount of GH₵ 737,767.20 ($151.596.00) and GH₵8,853,206.40 ($1,819,152.00) per month and year respectively for the two watersheds is significantly higher than proceeds from Ecotourism generated annually. This means the implementation of a PES programme could provide significant and sustainable financing for watershed management and conservation actions. Current funding for the protection and restoration of the watershed is relatively limited and ad hoc. Therefore, the outcome of this research presents a major opportunity for long-term funding options for the Forestry Commission and other stakeholders involved in the management for the Owabi and Barekese watersheds. In the light of the increasing forest degradation and deforestation expansion of urban fringe towards watersheds, these values could better inform decision-making in terms of whether to conserve the watersheds to enhance the water quality and supply. These would also be useful in addressing the challenges of forest degradation and deforestation while providing incentives for upstream communities to protect the watershed.

It is acknowledged that before the institution of payments ecosystem services, a clear connection should be made between the biophysical provision and use by people [5,40]. Economic valuation of ESs is based on the concept of willingness to pay, and it is based on the assessment of individuals' preferences which is the foundation for 'welfare economics' [19,32,76]. It important to differentiate within the context of willingness to pay the responses in terms of demographics and other factors [68]. The study further that WTP amount is largely influenced by respondent's age, years of residence and number of people per household. The observation is comparable with studies that found age, years of residence and household size as some of the demographic factors that positively influence peoples' willingness to pay [[19,32,61,77],]. However, studies found other socio-economic characteristics including occupation, income, and education to be related to respondents' WTP for ecosystem services [4,25,78]. Interestingly, the study found that the younger generation were willing to pay more compared to the older generation. This observation could be attributed to the fact that this age group represents the active and energetic population as well as those likely to be affected by degradation of the watershed [19,31,32] and in the long-term by loss of ESs. This observation however, contrast with other studies that found older respondents were willing to pay higher amount than younger [79,80]. On other hand, the women were willing to pay high amount than men. This observation is consistent with other studies that found that women were willing to pay to support conservation projects [16,19,81]. It is widely acknowledged that when it comes to the social and economic repercussions of issues connected to the environment and conservation, women usually pay the price [82,83]. Because most women are heavily reliant on the environment it to meet basic needs, the degradation of the environment has a greater immediate impact on them. For instance, most women in tropical countries rely heavily on the stability of their immediate surroundings for their survival, and as that environment deteriorated, women have been more negatively affected than men [83,84]. Due to their work as gatherers of non-timber forest products, rural women are in a unique position to identify possible challenges to the sustainability of the physical environment and natural resources [83,84] and are therefore eager to support their conservation.

The results also suggest downstream have a high interest in watershed conservation and are willing to contribute towards the conservation of the Barekese and Owabi watersheds to enhance the provision ecosystem services. Generally, the WTP illustrate the importance people attached to nature conservation and the need to sustain as well as improve the ecosystem services that is derived from conservation areas. These trends are signs of public backing for conservation, and strong preference for green development. Policy makers and resource managers could utilize these observations as further push for judging public support for conservation and restoration through watershed programmes, or in determining support for watershed protection in Ghana. The WTP could be a useful indicator of future public behaviour if a conservation fund were to be established [62,85].

It important highlight that household income usually has a positive relationship with WTP in favour of conservation outcomes [25,79,80]. A major limitation of the study was that income levels of respondents were not elicited during the survey. Higher household income usually has a positive relationship with WTP and influences the implementation strategies for PES programmes. This could allow for segregation of WTP for different income brackets of ES beneficiaries. Also, the collection of categorical data did not allow for rigorous regression analysis and therefore future research will have to improve the current study taking into the limitations of this study.

5. Conclusion

This paper presents the first application of the CVM to estimate mean WTP for the Barekese and Owabi watersheds in Ghana. This study has estimated a mean WTP value of GHC7.3 ($1.5) and aggregate of GH₵ 737,767.20 ($151.596.00) and GH₵8,853,206.40 ($1,819,152.00) per month and year respectively for the two watersheds. The study further enhances understanding of the influence of demographic factors on WTP and the important role these factors play in peoples' WTP. This study demonstrates the importance of Barekese and Owabi watersheds by highlighting local perceptions on Willingness to Pay for nature conservation and improvement. The

WTP highlight the importance of the watershed to the local economy and the benefits downstream communities derive from them. The Barekese and Owabi watersheds presently provides drinking water that is marketed commercially. Unlike other studies where the WTP is based on diffuse sources, the WTP for this study is based on point source financing based on monthly water bills that customers pay. This makes the implementation of PES easy and a more sustainable stream of resources to support watershed conservation in Ghana and elsewhere. These findings could be useful information to guide the development of resource management strategies and policies that explore sustainable financing options.

Furthermore, the outcome of the study offered useful insights for planning and implementing of a PES programme, that may enhance watershed conservation while also assisting upstream land holders by offering economic possibilities. This information could support policy makers in making suitable land management choices in a landscape experiencing fast changes in land use owing to population increase and urbanization, since it emphasizes local users' perspectives on watershed protection and its relevance. Decision-makers could adopt policy decision to conserve the Barekese and Owabi watersheds to optimize the flow of ESs that are locally and regionally valued. This study might be valuable elsewhere, principally in developing countries, where upstream-downstream linkages are prevalent and how upstream populations play a central role in protecting ecosystems and flow of ES to downstream communities.

Data availability statement

The raw data associated with this article can be found at https://doi.org/10.1016/j.envc.2021.100300.

CRediT authorship contribution statement

Samuel Ayesu: Writing – original draft, Visualization, Software, Project administration, Methodology, Investigation, Funding acquisition, Formal analysis, Data curation, Conceptualization. **Olivia Agbyenyaga:** Writing – review & editing, Supervision, Methodology, Conceptualization. **Victor Rex Barnes:** Supervision, Methodology, Conceptualization. **Richard Krobea Asante:** Writing – review & editing, Software, Project administration.

Declaration of competing interest

The authors declare the following financial interests/personal relationships which may be considered as potential competing interests:Samuel Ayesu reports financial support was provided by International Tropical Timber Organisation. Samuel Ayesu reports a relationship with International Tropical Timber Organisation that includes: travel reimbursement. No.

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