Willingness to Pay for Watershed Services by Downstream Water Users in Babati District, Tanzania

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DOI: https://doi.org/10.62277/mjrd2024v5i20046

ARTICLE INFORMATION

Article History

Received: 27th October 2023
Revised: 04th April 2024
Accepted: 10th April 2024
Published: 10th June 2024

Keywords

Willingness to pay
Contingent valuation method
Watershed
Payment for ecosystem Services
Water users

ABSTRACT

Payment for Ecosystem Services promotes watershed management through Payment for Watershed Services. It encourages improved land management practices in upstream areas to enhance the quantity and quality of water downstream. The Nou Forest Reserve in Babati district covers Lake Manyara's headwaters. Its rivers are the primary water source for the area's inhabitants. However, there have been reports of declining water quality and quantity, presenting an opportunity to introduce payment for watershed services for Nou Forest Reserve conservation and management. The present study was conducted to assess the level of awareness among downstream water users about the importance of watersheds in providing sustainable water supply. Using the Contingent Valuation Method, the study estimated the communities' willingness to pay for improved watershed services, analysed factors influencing capacity to pay, and examined possible operational modes for implementing payment mechanisms. A total of 155 domestic water users and 50 non-domestic water users were interviewed. It was found that 71% of domestic water users and 82% of non-domestic water users were willing to pay for improved watershed services, with a mean willingness to pay estimated at TAS 1261 per user/year for domestic water users and TAS 112322 per user/year for non-domestic water users. Factors such as gender, occupation, education, and farm size significantly (P<0.05) influenced water users' willingness to pay. Income was a significant factor in the willingness to pay for non-domestic water users, but it was not significant for domestic water users. The current study suggests that downstream water users in Babati district, who act as watershed service buyers, could collect a water user fee based on estimated amounts. This approach would help address declining water quality and quantity through improved watershed management and thus enhance watershed conservation and management.

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1.0 Introduction

Payment for ecosystem services (PES) is a direct conservation approach that compensates providers (upstream communities) for their direct or indirect contribution to ecological service maintenance (Maryrand and Paquin, 2004; *Branca et al.,* 2009). Existing PES schemes encompass compensation for water provision (Dudley and Stolton, 2003), forest carbon through REDD+ mechanisms (Burgess et al., 2010), and the achievement of biodiversity outcomes (Gross-Camp et al., 2011). When payment for watershed services (PWS) is used to encourage watershed management, it leads to better land management practices upstream that protect and improve the amount and quality of water downstream (Engel et al., 2008; Wunder, 2007; Maitreet al., 2001; Johnson et al., 2000). Different studies conducted on WTP using the Contingent Valuation Method have shown divergence among different communities, implying that willingness to pay is a site-specific aspect if the project is to be implemented sustainably (Wunder, 2007).

The Nou Forest Reserve (NFR) in Babati district covers the headwaters of Lake Manyara (Sangeda and Mosha, 2011). The rivers within the forest serve as a primary water source for household use, livestock, and agricultural irrigation, located both nearby and in distant locations (Sangeda and Mosha, 2011). Local water users have reported a significant decline in both water quality and quantity in the NFR, despite its recognition as a crucial water source for numerous rivers in the region (Sangeda and Mosha, 2011). This decline is a result of human activities conducted by upstream communities, which have had a detrimental impact on the overall water resources (Sangeda and Mosha, 2011). This presents an opportunity to introduce PWS for NFR conservation and management. However, it is still unknown whether downstream water users are willing and able to pay extra fees for watershed services, how much they know about how important watersheds are for ensuring a sustainable water supply, and how the WTP works and what factors affect it. As a result, this study aimed to address these gaps and provide valuable insights into the potential adoption of PWS in Babati District, which serves as one of the country's pilot areas and can be scaled up to other areas with similar settings in Tanzania.

2.0 Materials and Methods

2.1. Study Area Description

The study was conducted in four villages (Dareda Kati, Seloto, Mawemairo, and Manyara) situated on the borders of the NFR in Babati District, northern Tanzania. Babati District, located between latitudes 4° 13' 0.01" S and longitudes 35° 45' 0.00" E, covers an area of 6069 km^2, with a significant portion (640 km^2) occupied by water bodies such as Lake Babati, Lake Burunge, and Lake Manyara. Babati district consists of four divisions with 21 wards and 82 villages. Approximately 90% of the Babati District population resides in rural areas and relies on agriculture and livestock for their livelihood (Kavishe, 2013). The Dabil-Dareda escarpment of the Rift Valley divides the district, resulting in diverse climatic and agro-ecological zones ranging from humid highlands (2150–2450 m a.s.l.) to semi-arid lowlands (950–1200 m a.s.l.) (Babati profile, 2002). The rainfall pattern in the area is bimodal, with short rains occurring from November to December/January and long rains from February to May (Sambrook et al., 2004). The NFR in Babati district serves as the origin of numerous permanent rivers such as Erri, Nambis, Gilawu, Bubu, Endamanang, and Dongobesh, as well as streams like Endayaya, Endallaha, Yaeda, Gidng'ata, and Bimbili (FARMAfrica, 2014). These waterways are the primary sources of water for local inhabitants, livestock, and agricultural irrigation farms located both nearby and at distant locations (FARMAfrica, 2014). Furthermore, several rivers from the forest flow into salt lakes, including Manyara, Eyasi, and Balangida, which are situated at the foot of the rift valleys.

2.2. Research Design

The study targeted downstream water users in Babati District, with a specific focus on domestic water users, large-scale commercial sugar cane farmers, small-scale paddy rice and cereal crop farmers, Lake Manyara Park, smallholder farmers, and large ranches. This study employed a cross-sectional research design to collect empirical data from Babati District, incorporating both quantitative and qualitative data from primary and secondary sources. The study collected quantitative data on the WTP for watershed services from downstream water users, adhering to the principles of the contingent valuation method (CVM) in line with the study's objectives.

2.3. Sample Size and Sampling Procedure

The study consisted of two distinct sample units: domestic water users and non-domestic water users, reflecting variations in consumption demand. To ensure effective sampling from a large population, a multistage sampling technique was employed for the selection of domestic water users. We purposefully selected four out of the 21 wards in the first stage: Dareda, Alaghai, Magugu, and Magara, as they receive water from the Nou Forest Reserve. Next, we purposely selected one village from each ward, specifically Dareda Kati, Seloto, Mawemairo, and Manyara, because of their reliance on forest water for domestic purposes. The final step involved the random selection of households within the chosen villages, utilising a simple random sampling method. Using the formula by Boyd et al. (1981), we sampled a total of 155 water users, representing 5% of the villages' population.

$$C = \frac{n}{N} \times 100 \quad (1)$$

Where C represents a figure greater or equal to 5% of the village population, N is the total population in the villages, and n is the number of sampled domestic water users. The 5% threshold was considered sufficient, ensuring that the sample size did not fall below 30. Similarly, Bailey (1994) recommended a minimum of 30 cases to effectively represent the population under study, so we purposively sampled 50 non-domestic water users from the wards.

Table 1

Sample Size Summary Table of Participants in Manyara Region (Babati District)

Ward	Village	H/H Population	Downstream water users
Alaghai	Daredakati	1024	55
Dareda	Seloto	672	34
Magugu	Mawemairo	588	31
Magara	Manyara	716	36
Total		**3000**	**155**

2.4. Data Collection

2.4.1. Questionnaire

We collected primary data directly from the field through face-to-face interviews with water users, based on questionnaires for WTP and focus group discussions. Prior to data collection, we conducted a preliminary survey to familiarise ourselves with the study area and gather initial data for general information on watersheds and water consumption. We pre-tested the questionnaire with ten respondents to ensure its validity and reliability. It consisted of four parts. The first part focused on gathering background information, specifically regarding the socio-economic characteristics of the respondents. The second part addressed the respondents' awareness of watersheds, providing a briefing on watershed concepts and their significance in ensuring sustainable water supply, followed by knowledge-based questions pertaining to protected areas, water supply issues, and the importance of watershed management. The third part assessed the respondents' willingness to pay for improved watershed services. Lastly, the fourth part examined the respondents' preferences regarding the operational mode for implementing payment for watershed services.

2.4.2. Focus Group Discussion

We conducted two focus group discussions (FGDs) with both domestic and non-domestic water users to gather their understanding of the role of watersheds in providing sustainable water supply, the factors influencing WTP, and their preferred operational mode. For domestic water users. The group consisted of the village's leaders, namely the village chairperson, village executive officer, and environmental committee leader, as well as three villagers whose households were not part of the survey. We randomly selected one respondent from each industry or sector to represent the unit in the discussion for non-domestic water users. We asked the FGD participants if they would be willing to pay for improved watershed services. We asked the "yes" respondents an open-ended question about the highest annual amount they would be willing to pay. In this study, we used the results of this activity to generate bid amounts for further assessment.

2.4.3. CVM Method in Collecting WTP Information

In this study, we set up a hypothetical market to improve water services and describe the benefits of watersheds in the CV questionnaire. To ensure realism and plausibility, the CV questionnaire accurately described the water services and watershed benefits. We applied the discrete choice method to establish an appropriate binding figure, asking respondents to name the amount they were willing to pay. We used a dichotomous choice in this case, which does not ask an individual to specify a preferred amount but rather to "take it or leave it" with a "yes or no" answer (Bishop and Heberlein, 1979). We included a debriefing question about the mode of payment in the questionnaire to increase the respondents' acceptance.

2.5. Data Analysis

We statistically analysed the data from the CV questionnaire using the Statistical Package for Social Science (SPSS). We used descriptive statistics to analyse the respondent's awareness of watersheds. We used the respondent's descriptive statistics to describe the frequency and percentages of water users in the data. We did this to understand and describe all the variables in the data set, as well as to ensure additional quality assurance and control measures (Gunatilake et al., 2007).

We estimated the WTP for a change in environmental quality using a standard probit model and Bayesian techniques. This is because maximum likelihood estimation remains by far the most common method for estimating WTP from dichotomous-choice CV surveys. Some studies have employed Bayesian estimation, including Yoo (2004), Li et al. (2009), and Mueller (2013). Traditional maximum likelihood estimates of WTP require additional simulations using techniques such as the Krinsky and Robb (1986) method to obtain a WTP distribution. In contrast, the WTP post-Bayesian estimation draws provide a WTP distribution without any further simulation (Mueller, 2014). Given these facts, we chose a Bayesian estimation for its relative convenience in obtaining a WTP post-estimation distribution.

We ran the probit regression analysis using the STATA 11.0 package. We applied the probit model to analyse the factors that influence respondents' willingness to pay, adopting it due to its ability to explain yes-or-no decisions by a set of variables related to respondents' characteristics and bid price (Hanneman, 1984). We used the robust standard error, not the normal standard error, to address the heteroscedasticity problem. Following Cameron and James (1987), the standard probit model was based on the assumption of an underlying WTP function.

$$WTP_i = Xi'\beta + \mu_i \quad (2)$$

Where: Xi' = Vector of explanatory variables

β = Vector of estimated coefficients

μ = A random error

The researcher cannot observe the WTP function directly, but the respondents' "vote" on the WTP question represents the latent WTP. Let y_i represent the respondent's vote, i.e. 1 if 'yes' and 0 if 'no'. Assume μ_i are independent and normally distributed with a mean 0 and standard deviations Ơ, and Bid_i is the randomly assigned bid amount for each respondent $_i$. The probability of a 'yes' vote given the explanatory variables and random error is equal to the probability that the individual's unobserved WTP is greater than the bid amount (Mueller, 2014).

Therefore:

$$\Pr(y_i = 1|X_i) = \Pr(WTP_i > Bid_i) \quad (3)$$

$$= \Pr(X_i\beta + \mu_i > Bid_i) \quad (4)$$

$$= \Pr(\mu_i > Bid_i - X_i\beta) \quad (5)$$

$$= \Pr(Z_i > \frac{Bid_i - X_i\beta}{Ơ} \quad (6)$$

Where:

Z_i = the standard normal random variable
Ơ = a variance parameter

We calculated the mean WTP using the probit parameter estimates. Following Hanneman (1984), the mean WTP from a standard probit was as follows:

$$mean\ WTP = -\alpha / \beta \text{Bid} \quad (7)$$

Where:

$$\alpha = \beta o + (\beta_1 * \bar{x}_1) + (\beta_2 * \bar{x}_2) + ... (\beta k_{-1} * \bar{x}k_{-1}) \quad (8)$$

We predicted WTP as a function of the following explanatory variables, with the exception of Bid:

Table 2

Variables Description and Coding

Variable name	Variable description
WTP	Dependent variable (yes/no response to WTP). This takes a value 1 for yes and 0 for no
Age	Number of years of the respondent
Education	Number of years in school of the respondent
Gender	Gender, 1 if respondent is male, 0 if female
Occupation	Occupation, 1 if respondent is engaged in agriculture, 0 otherwise)
Family size	Number of individuals in the household
Income	Income of respondents (TAS)
Farm size	Hectares of the farm
Awareness	Awareness, 1 if respondent is aware with watershed, 0 otherwise

3.0 Results and Discussion

3.1. Socio-economic Characteristics of Respondents

Table 3 below summarises the socio-economic characteristics that influence the respondents' WTP for improved watershed services. It encompasses respondents' gender, age, marital status, family size, education level, main occupation, farm size, and income level.

Both genders were involved in interviews; the idea was to gather information in a more balanced way and have opinions from both males and females.

The survey results indicated a higher percentage of male (57.4%) respondents compared to female (43.6%) respondents, as illustrated in Table 3. This gender distribution allowed for more accurate information on various aspects related to WTP for improved watershed services because most heads of households and landowners in the study area were men (Ogunniyi et al., 2011). Additionally, cultural and traditional norms in the area often lead many females to rely on their husbands for decision-making. These findings align with a study by Ndetewio et al. (2013), which similarly reported a male predominance of 67.6% over female respondents.

Table 3

Distribution of Domestic Water Users by their Characteristics (N=155)

Variable name		Frequency	Percentage (%)
Age	18-29	31	20.0
	30-39	68	43.9
	40-49	43	27.7
	Above 50	13	8.4
Gender	Male	89	57.4
	Female	66	42.6
Education level	No formal education	18	11.6
	Elementary level	8	5.2
	Primary level	68	43.9
	Secondary level	50	32.3
	Vocational	11	7.1
	University/College level	0	0
Marital status	Single	39	25.2
	Married	116	74.8
Occupation	Agriculture	143	92.3
	Livestock keeping	5	3.2
	Formal Employment	7	4.5
Family size	1-3	46	29.7
	4-6	73	47.1
	7-8	33	21.3
	Above 10	3	1.9

The study revealed that most of the respondents were married, indicating that they have family responsibilities. Mshigwa (2014) conducted a study on the willingness of domestic water consumers in Chalinze town to pay for watershed management, which aligns with these findings. The study emphasised the significant role of marriage, highlighting that respondents bear the responsibility of ensuring an adequate and clean water supply within their households. This responsibility may influence their willingness to pay for improved watershed services, as they recognize the opportunity to secure a more reliable water supply.

Regarding educational attainment, the study revealed that 43.9% of the respondents completed primary school, while 32.3% reached secondary school. This indicates that most of the respondents have at least basic education, which equips them with an understanding of the importance of conserving the watershed to enhance its services, particularly in terms of providing a clean and reliable water supply for their own benefit. Their knowledge of watershed services and their importance may influence their willingness to participate in payment for their improvement. Khan (2010) supports this finding by emphasising that education-based awareness influences respondents' willingness to pay. The current study findings are similar to those of Tang (2013), who reported that respondents in Northwest China had predominantly low levels of education, with 53% not having received a high school education. The size of the family is also likely to influence the WTP for watershed services (Ndetewio, 2013). This is because a larger family size requires a greater quantity of food, resulting in a higher demand for productivity per unit of land. As a result, a secure water supply is more important for larger households compared to smaller ones. The survey findings indicated that 47.1% of family sizes in the study area fall within the range of 4-6 people (Table 3). This finding is similar to Calderon (2013), who observed that the average household consisted of three adults and one child, with two earners per household.

According to the study's findings, 92.3% of respondents engaged in agricultural activities as their primary source of livelihood. This is due to the fertility of the soil in the study area, which encourages agricultural practice. Another factor contributing to this trend is that the majority of respondents only completed their primary education, which could potentially limit their access to formal employment opportunities, leading them to rely on agriculture as their primary source of income. Given that they primarily engage in activities related to the natural environment, the fact that most respondents practice agriculture may influence their WTP for improved watershed services. These findings are similar to those of Mshigwa (2014), who found that 49.4% practice farming as their main economic activity.

Table 4 shows that 52.3% of the surveyed domestic water users who engaged in agricultural activities owned farms with a size of 1-3 hectares. This suggests that most of the domestic water users who practice agriculture were small-scale farmers. On the contrary, 68.7% of non-domestic water users had farms whose size was above 6 hectares, implying that they are relatively large-scale farmers compared to domestic water users. We expect farmers with large plots to have a higher WTP than those with small plots (Ndetewio, 2013), as their production is likely to be higher than that of small farms.

Table 4

Farm Size of the Respondents

Farm size (hectare)	DWU	%DWU	NDWU	%NDWU
Below 1	59	38.1	0	0
1-3	81	52.3	0	0
4-5	12	7.7	12	23.5
Above6	0	0	35	68.7
Without farm	3	1.9	4	7.8
Total	**155**	**100**	**50**	**100**

DWU-*domestic water users*, NDWU-*non-domestic water users*

Figure 1
Income Level (TAS) of Domestic Water Users

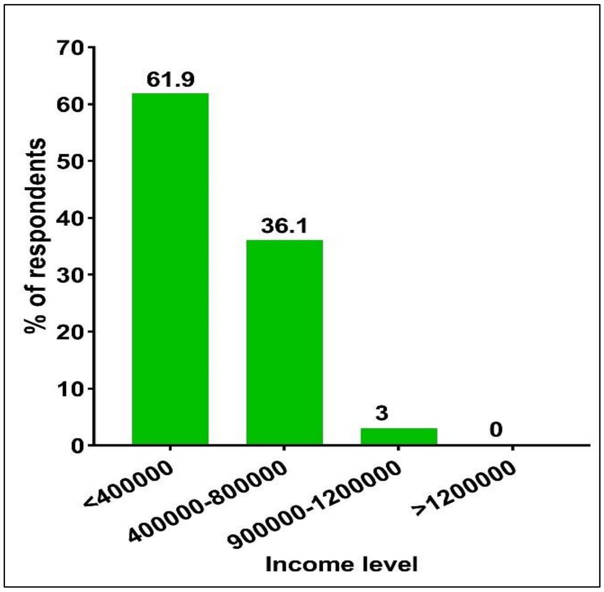
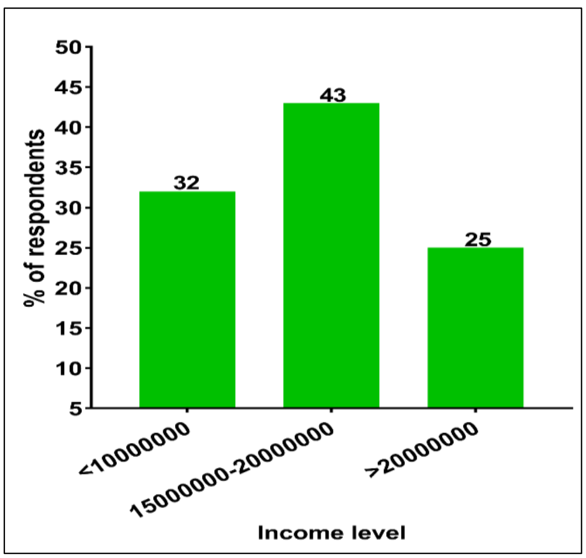


Figure 2
Income Level (TAS) of Non-Domestic Water Users



Income is an important factor that determines the WTP for watershed services. The findings of the study indicate that the majority (61.9%) of domestic water users have an income less than 400 000 TAS (Figure 1). These results are consistent with those reported by Mwanyoka (2005), who found that 70% of respondents earn an average of 400 000 TAS per year. Table 3 indicates that small-scale agriculture is the primary occupation, contributing to the low income levels. Consequently, the relatively low income levels may result in a lower willingness to pay for improved watershed services among domestic water users. On the other hand, non-domestic water users showed a high percentage of respondents (43%) with incomes ranging from 15,000,000 to 20,000,000 TAS (Figure 2). This is because most non-domestic water users engage in large-scale agriculture, which yields a higher income than small-scale farmers, who rely on agriculture for both food and income. Vargas (2004) noted that farmers with higher income levels demonstrated a 33–39% increase in willingness to pay for watershed services. Therefore, income plays a crucial role in influencing the willingness to pay for improved watershed services.

3.2. Level of Awareness on the Importance of Watershed

3.2.1. Knowledge on Water Source

A large percentage of both domestic water users (76.8%) and non-domestic water users (80%) demonstrated a high level of awareness regarding the NFR as a watershed and identified it as their primary source of water (Table 5). This indicates that most respondents possess knowledge about their water source, recognise its importance, and are willing to pay for its improvement. Their reliance on NFR watershed services for income and sustainable livelihood underscores the importance of understanding the environment. Moreover, since the respondents have an average age of 35 and serve as heads of households, it is crucial for them to be familiar with the natural environment, as they are responsible for ensuring a clean and sustainable water supply for their families. A study in Tuguegarao City on domestic users' willingness to pay for watershed protection revealed a lack of awareness among the respondents regarding watershed concepts (Amponin et al., 2007), which contrasts with these findings. However, these results align with those of Mshingwa (2014) in Bagamoyo District, which indicates that nearly 98% of the respondents had a higher level of awareness about the Wami Basin as a watershed.

Table 5

Responses on Knowledge of Watershed and Source of Village Water Supply by the Respondents

Knowledge on watershed	**Percentage (DWU)**	**Percentage (NDWU)**
Yes	76.8	80.0
No	23.2	20.0
Total	100	100
Source of village water supply		
Nou Forest reserve	72.9	76.7
I don’t know	27.1	23.3
Total	100	100

DWU-*domestic water users*, NDWU-*non-domestic water users.*

3.2.2. Importance and Roles of Watershed for Sustainable Water Supply

The majority of domestic water users recognised the role of watersheds in providing various services such as hydroelectric power, biodiversity conservation, and recreation (Table 6). Non-domestic water users, on the other hand, specifically emphasized that the watershed is their primary source of water. This discrepancy can be attributed to the respondents' level of education, as indicated in Table 3, where most of them had primary education, enabling them to understand the roles of watersheds in their community. Calderon (2013) reported similar findings in Oroqueta City, where many people expressed awareness of the watershed's roles and expressed concerns about the potential decrease in water quality if Mt. Malindang remains unprotected. Among the domestic water users, the two main reasons for considering watershed protection important were ensuring a more sustainable water supply and improving water quality (Table 6). The water used by downstream water users is often contaminated due to pollutants introduced by upstream communities, making watershed improvement crucial. Additionally, since most respondents engage in agriculture, they require an adequate water supply to enhance farm production. On the other hand, non-domestic water users perceived the watershed as vital for providing a sustainable water supply. These findings are consistent with a study by Mueller (2013), which highlighted the respondents' perception of watershed health as crucial for ensuring a sustainable water supply.

Table 6

Importance and Roles of Watershed for Sustainable Water Supply by Respondents

Indicator	**%DWU)**	**%NDWU**
Roles of watershed		
Watersheds are the primary source of water	20.6	43.3
Watersheds provide other goods like timber, and animal and plant products	27.1	10.0
Watersheds provide other services like hydroelectric power, biodiversity conservation and recreation	29.0	20.0
Good forest cover enhances the way watersheds provide various goods and services	23.2	26.7
Total	**100**	**100**
Importance of watershed		
It absorbs water and make this available for future use	1.3	0
It minimizes floods during the rainy season	1.3	0
Provides more sustainable water supply	30.3	30.0
It improves water quality	34.8	23.3
To avoid forest/nature destruction	21.9	26.7
Reasons to why it is not important		
It doesn’t directly affect my household	5.8	0
I don’t believe in its role in improving water supply	4.6	20.0
Total	**100**	**100**

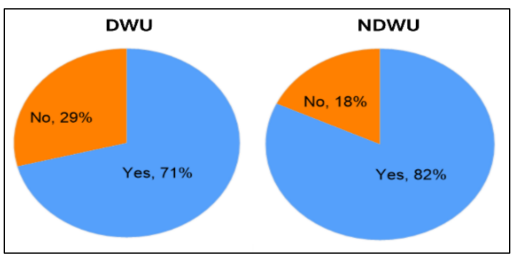
DWU-*domestic water users*, NDWU-*non-domestic water users*

3.2.3. Willingness to Pay for Watershed Services by the Downstream Users

The study found that more than half (71% and 82%) of both domestic and non-domestic water users, respectively, expressed willingness to pay a specified amount for watershed protection (Figure 3). These findings are consistent with Ogunniy et al. (2011), who reported a 75% willingness to pay for improved water quality. This indicates that respondents are willing to contribute financially to enhance watershed services beyond their current state. The high level of awareness among respondents, as observed in Table 5, further supports their willingness to participate in improving watershed services and contribute financially to ensuring a sustainable water supply. Jimin et al. (2012) in Yibin City, China, found that people's awareness of environmental issues positively influences their willingness to engage in environmental protection.

Figure 3

Response on Willingness to Pay Question by the Respondents for DWU (Domestic Water Users) and NDWU (Non-Domestic Water Users)



3.3. WTP from the Bid

The study inquired about the amount respondents were willing to contribute for improved watershed services. Table 7 presents the declared amounts in TAS/user/year. Notably, non-domestic water users were willing to pay a higher amount (ranging from 50000 to 300000 TAS) compared to domestic water users (ranging from 500 to 2000 TAS). The higher income levels of non-domestic water users, compared to the relatively lower incomes of domestic water users, account for this disparity. Furthermore, we observed that the TAS 1000 bid amount for domestic water users was more frequent than TAS 500. Similarly, for non-domestic water users, TAS 100,000 had a higher frequency compared to TAS 50,000 (Table 7). This indicates that the likelihood of accepting a bid increases with the amount offered. These results suggest that despite their lower income, the downstream water users in Babati District were willing to pay the maximum amount they could afford for improved watershed services. These findings are inconsistent with several literature sources, such as Akter (2007), which indicate a negative relationship between bid amount and willingness to pay. According to Akter's study, as the bid amount increased, respondents' willingness to pay decreased.

Table 7

Reported WTP from the Bid by Domestic Water Users

Bid	Frequency	Percentage
500	20	13
1000	45	29
1500	21	13.5
2000	24	15.5
Total	110	71

Table 8

Reported WTP from the Bid by Non-Domestic Water Users

Bid	Frequency	Percentage
50000	15	30
100000	17	34
200000	7	14
300000	2	4
Total	41	82

To understand their motivations, we asked those who expressed a willingness to pay to explain their decision. The primary reasons identified by both water user groups were the desire for a clean and reliable water supply (Table 9). The majority of water users rely on agriculture for income, which necessitates a dependable water supply to enhance farm productivity. Additionally, the need for clean water is crucial for maintaining good health. The respondents also recognised their responsibility as water users to contribute towards improving watershed services, as they would be the ones benefiting from these improvements. This finding aligns with the Amponin et al. (2007) study, which explored potential explanations for willingness to pay among water users. In their study, 78% of respondents expressed the desire for a more reliable water supply, while 21% emphasised the importance of watershed protection for the sake of future generations.

Table 9
Reasons on WTP Question for Improved Watershed Services by the Respondents

Indicator	Percentage (DWU)	Percentage (NDWU)
Reasons for willingness to pay		
I want clean and more reliable water supply	30.3	33.3
It is my duty as a water user	16.8	26.7
I want the watersheds to continue producing other environmental services, biodiversity conservation and recreation	14.2	13.3
I would like the future generations to have reliable water supply	9.7	10.0
Reasons for not willing to pay		
I cannot afford to pay any additional amount to what I am currently paying	12.9	0
I think the current waters price could recover the water supply cost	9.0	6.7
I think it should be the government that finances the watershed management activities	6.5	6.7
I do not believe that any additional payment will result in improved watershed services	0.6	3.3
Total	**100**	**100**

DWU-*domestic water users*, NDWU-*non-domestic water users.*

The respondents who were unwilling to pay stated that they could not afford any additional payments beyond what they currently contribute (Table 9). This limitation stems from their income constraints, primarily caused by their involvement in small-scale agriculture. This group argued that the responsibility of financing conservation activities is for the government, as they are already making payments through water user rights. These findings align with Bautista's (2003) assertion that non-willingness to pay may stem from communities recognising their entitlement to good water quality and expecting unrestricted access to it without additional financial burdens. Users are accustomed to accessing services for free due to their inability or lack of income to make payments.

3.4. Factors Affecting Willingness to Pay

The model summary's results show that the number of observations in the model was 152 (domestic water users) and 50 (non-domestic water users). The Wald chi² or likelihood ratio (LR) chi-square test of 1334.79 (domestic water users) and 35.94 (non-domestic water users) implies the goodness of fit of the overall model as in an F test. We compared the p-value with the critical value, 0.05 or 0.01, to ascertain the statistical significance of the overall model. In this case, the model was statistically significant because the p-value was less than 0.01.

Table 10
Probit Regression for Non-Domestic Water Users

WTP	Coefficient	Robust Std. error.	Z	p>|z|	[95% Conf. Interval]	
Income	0.001	0.001	2.880	0.004**	0.001	0.001
Farm size	-0.768	0.306	-2.510	0.012**	-1.367	-0.169
Awareness	-0.543	0.741	-0.730	0.464	-1.995	0.909
Constant	-2.310	0.876	-2.640	0.008	-4.026	-0.592

Obs = 50, *Wald* chi^2 *(4)* =35.94, *Prob>*chi^2 = 0.0000, *Pseudo* R^2 = 0.6824, *Log likelihood* = -7.4858043

The significant variables in the model were gender, occupation, education, and farm size, each showing different levels of significance. We found income to be significant for non-domestic water users, but not for domestic water users. However, the results also showed that respondents' age, family size, and awareness did not significantly impact their willingness to pay for improved watershed services.

3.4.1. Gender

Gender had a significant negative impact on the WTP for improved watershed services, indicating that female household heads had a higher WTP compared to male household heads. The study area's cultural norms primarily assign women to household chores such as water collection and family hygiene. When fetching water, they are more likely to feel the burden of long distances. These findings agree with a study by Ogunniyi (2011) that also reported lower WTP among males compared to females. These results, however, contradict Ma's (2012) findings, which suggested a positive influence of gender on WTP but were not sufficient to influence WTP.

Table 11
Probit Regression for Domestic Water Users

WTP	Coefficient	Robust Std. error.	Z	p>|z|	[95% Conf. Interval]	
Age	-0.019	0.048	-0.39	0.693	-0.113	0.0756
Gender	-4.821	1.093	-4.41	0.000*	-6.964	-2.678
Occupation	3.881	1.066	3.64	0.000*	1.792	5.971
Income	-0.001	0.001	-1.02	0.309	-0.000	0.001
Family size	0.326	0.270	1.21	0.226	-0.203	0.858
Education	-0.226	0.086	-2.61	0.009**	-0.396	-0.056
Farm size	1.107	0.375	2.95	0.003**	0.372	1.841
Awareness	0.562	0.582	0.96	0.335	-0.597	1.703
constant	-4.667	3.016	-1.55	0.122	-10.578	-1.244

Obs =152, *Wald chi² (9)* =1334.79, *Prob>chi²*=0.0000, *Pseudo* R^2 = 0.9118, *Log likelihood* = -8.0635252

3.4.2. Occupation

The occupation had a statistically significant and positive correlation with WTP. Respondents who engaged in agricultural activities as their primary source of income demonstrated a higher WTP compared to those who were not dependent on agriculture. This is because improved watershed services result in a more reliable water supply, directly contributing to increased agricultural production. As agricultural production rises, a larger portion of their income comes from agricultural activities. Kong (2014) conducted a study in China that supports this observation, finding that farmers whose household income primarily comes from planting, breeding, and other traditional industries are more likely to benefit from environmental quality improvements and thus exhibit a greater willingness to compensate for the environment. Vargas (2004) reported similar findings, indicating a stronger WTP among farmers who heavily rely on agricultural products for their income.

3.4.3. Education Level

Respondents' education level negatively affects their WTP for improved watershed services (*P<0.009*). This implies that as education levels rise, the WTP for such services decreases. The predominance of respondents with only a primary education in the study area may have limited their access to formal employment, explaining this finding. Consequently, many respondents had to rely on agricultural activities for their income and thus placed a high value on the natural environment, regardless of their education level. Therefore, they are more inclined to pay for improved watershed services to ensure a sustainable water supply for their agricultural endeavors. These findings align with a study by Moffat et al. (2013), which found that educated individuals were less willing to pay for improved water quality and reliability in Chobe Ward, Maun, as they considered water services to be a government-provided entitlement. However, these results differ from those of Amponin et al. (2007), who reported that educated individuals had a better understanding of the future risk of reduced water flows on crop production and, consequently, recognised the importance of payment for watershed services.

3.4.4. Farm Size

Farm size significantly influenced the WTP for improved watershed services among domestic water users. This means that as the farm's size increased, the WTP for such services also increased. Ma's (2012) argument, which expects farmers with larger plots to contribute more money compared to those with smaller plots, finds support in this finding. Since domestic water users rely on agriculture for both income and food, those with larger plots likely earn more from farming. Therefore, a decline in environmental quality will impact their farming incomes. Hence, they are more willing to pay for improved watershed services. On the other hand, for non-domestic water users, farm size negatively influenced WTP. This implies that as the farm size increased, the WTP for improved watershed services decreased. The fact that non-domestic water users have smaller farms compared to domestic water users explains the discrepancy in results between these two user groups. Therefore, any disruptions, such as water scarcity, would result in significant losses for non-domestic water users. In contrast, non-domestic water users on larger farms may perceive such disruptions as minor setbacks to their overall production. This divergence explains why domestic water users have a significant positive influence on WTP for improved watershed services, while non-domestic water users have a significant negative influence.

3.4.5. Income

Unlike much of the existing literature, this study did not find a significant relationship between income and the willingness to pay (WTP) for improved watershed services among domestic water users. The correlation of household income with other explanatory variables in the model, such as education and occupation, may account for this lack of significance (Akter, 2007). It also suggests that most domestic water users place a high value on the natural environment, regardless of their income level. This observation is supported by a study by Ezebilo (2006) in Simbu province, Papua New Guinea, which found that income did not significantly affect Kegsugl village.

However, for non-domestic water users, income had a significant positive influence on the WTP for improved watershed services. This suggests that as income increases, the WTP also increases. The wider range of income levels among non-domestic water users provides greater opportunities for respondents with higher incomes to contribute more towards WTP compared to those with lower incomes. Additionally, since watershed services are a primary source of water supply for their activities, non-domestic water users are highly willing to pay for improved watershed services to ensure a sustainable water supply. These findings are in agreement with Tang (2013), who reported that respondents with higher incomes among non-domestic water users were willing to pay more for environmental services. As a result, non-domestic water users with higher incomes are more inclined to contribute to improving watershed services than those with lower incomes.

3.5. Estimation of WTP

Table 12

Mean WTP of Domestic Water Users

Variable	Coefficient	Mean	Coefficient*Mean
Bid	0.017		
Age	-0.019	37.631	-0.717
Gender	-4.821	0.5789	-2.791
Occupation	3.881	0.934	3.626
Income	-0.00005	478026	-19.279
Family size	0.326	4.908	1.608
Education	-0.226	8.263	-1.867
Farm size	1.107	1.691	1.871
Awareness	0.561	0.776	0.436
Constant	-4.667		-4.667
Total			-21.780
Mean WTP =	-(-21.780) / 0.017		1,281.18

Table 13

Mean WTP of Non-Domestic Water Users

Variable	Coefficient	Mean	Coefficient*Mean
Bid	0.0000674		
Income	4.40^{-07}	1.64^{07}	0.000
Farm size	-0.766	7.280	-5.588
Awareness	-0.543	0.600	0.326
Constant	-2.309		-2.310
Total			-7.572
Mean WTP =	-(-7.572)/0.0000674		112,344.21

The study revealed that domestic water users have a mean willingness to pay (WTP) of TAS 1281 per year per person, in addition to their regular fee for a fixed volume of water. Non-domestic water users, on the other hand, have a WTP of TAS 112,344 per person per year. Note that comparing different contingent valuation studies can be challenging due to the sensitivity of the results to the econometric specifications used (Bengochea-Morancho et al., 2005). However, we can state that the WTP for improved watershed services in Babati district is relatively low compared to other similar research findings. For instance, it is lower than the WTP of domestic water consumers in Chalinze town, which was TAS 5237 per person per year above the existing tariff (Mshingwa, 2014). Many respondents in Chalinze town have higher incomes, ranging from 400,000 to 800,000. Additionally, Kaliba's 2003 study in the Dodoma Region and Singida Region reported a WTP of TAS 32 per 20L of water, above the existing tariff, and TAS 91 per household annually, respectively. The high demand for water, and the local climatic conditions in those regions influenced the higher amount.

Environmental economic theory predicts an increase in demand for improved environmental quality with income (Moffet et al., 2013), which explains the lower WTP of downstream water users in Babati district due to their low income level. Therefore, the relatively low WTP in Babati district indicated that respondents are willing to pay the maximum amount they can afford. This suggests that WTP varies significantly depending on location and factors such as respondents' income (Wunder, 2007).

Another factor contributing to the lower WTP is the current climate of conflict observed in the study villages of Babati district, as indicated in Table 14. Many respondents expressed a preference for a separate agency or office to collect the fee. If users are dissatisfied with the service provided by the current management, they are likely to provide a lower amount for an increase in the water bill (Vasquez, 2014; Kong, 2014). However, it is important to note that the research does not provide conclusive evidence of this relationship, as the questionnaire did not include any specific questions aimed at capturing the degree of conflict between the community and water management in the study area.

3.6. Possible Operational Mode for Instituting the Payment of Watershed Services

Table 14

Reported Mechanism to Collect Watershed Management and Protection Fee

Indicator	Percentage (DWU)	Percentage (NDWU)
Amount to be added to water bill as a fee, which is to be managed by the council	3.2	0
A separate agency/office will collect the fee	42.6	63.3
Direct cash payments to water district	9.7	6.7
Village water committee	26.5	16.7
Catchment office	18.1	13.3
Total	**100**	**100**

DWU-*domestic water users*, NDWU-*non-domestic water users*

Both domestic and non-domestic water users expressed a preference for a separate agency or office to collect the fee, as shown in Table 14. A lack of trust in other mechanisms, like the village water committee, influenced this choice. A minority of respondents from both groups advocated for the council to manage the fee by adding it to their monthly water bill. This differs from the findings of Ramajo and Saz-Salazar (2012), who reported that increasing the current water bill was the preferred collection mechanism due to its credibility and familiarity. The results also contradict the findings of Calderon et al. (2005) and Amponian et al. (2007), who found that most respondents favored adding any payment to their monthly water bills. Similarly, Gatto (2014) proposed that each household should pay an annual regional tax as the best approach. Both non-domestic and domestic water users, as shown in Figures 4 and 5, expressed a preference for the same amount of payment for watershed management and protection. According to the respondents, this approach would be convenient as it would entail a single payment regardless of water consumption volume, income, hectare size, or household size.

Figure 4

Reported Basis of Charging the Watershed Management and Protection Fee by Non-Domestic Water Users

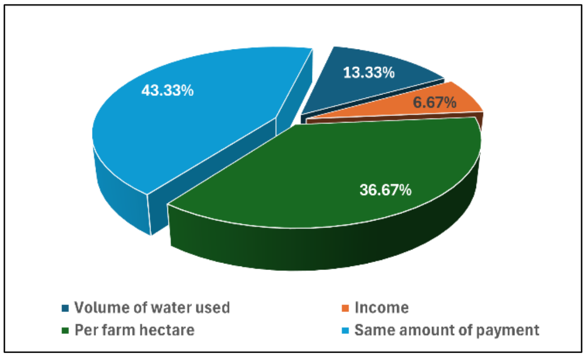
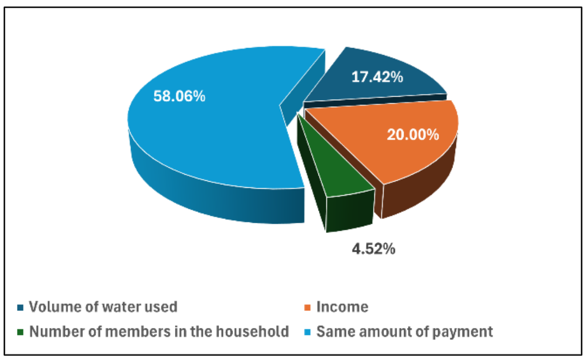


Figure 5

Reported Basis of Charging the Watershed Management and Protection Fee by Domestic Water Users



4.0 Conclusion and Recommendations

4.1. Conclusion

The respondents demonstrated a high level of awareness about watersheds and acknowledged their critical role in providing improved watershed services. They acknowledged the importance of managing and protecting watersheds to ensure a sustainable water supply and enhance water quality. Among downstream water users, more than half expressed WTP for improved watershed services. The estimated mean WTP was TAS 1281 per year per person for domestic water users and TAS 112,344 per year per person for non-domestic water users. We can attribute this relatively low mean WTP to the respondents' low incomes. Several factors influenced the respondents' WTP, including gender, occupation, education, and farm size, each at varying levels of significance. Notably, non-domestic water users found income to be significant, while domestic water users found it insignificant. Both domestic and non-domestic water users preferred the same amount of payment, considering it convenient to make a single payment irrespective of their income or other factors. Additionally, respondents expressed a preference for a separate agency or office to collect the fee, indicating a lack of trust in alternative mechanisms such as the village water committee.

4.2. Recommendations

Despite the respondents' level of awareness regarding the roles and importance of watersheds, there is a need for education to further expand the willingness of water users to embrace market-based instruments. The governments should provide environmental awareness to the public through initiatives like training programmes and media campaigns, highlighting the benefits of PES policies for both the environment and people's livelihoods. The study's findings revealed that the majority of respondents expressed a positive willingness to pay for improvements to watershed services. Therefore, we recommend that policymakers and decision-makers initiate the implementation of PES policies in the area. Additionally, we recommend representing downstream water users in watershed decision-making and management processes. The study's findings suggest integrating environmental education into both primary and secondary education to address the negative influence of education on willingness to pay. This could help increase respondents' willingness to pay for watershed services. Further research is necessary to investigate the factors that influence the willingness to pay for improved watershed services in the study area. We recommend that the government establish a legal and regulatory system to enforce payments for watershed services, taking into account the respondents' preferred collection mechanism and fee structure. This measure would serve to mitigate any apprehensions regarding the misappropriation of funds. Furthermore, it is important to note that this study solely focused on downstream water users in Babati district's willingness to pay for improved watershed services and did not consider the upstream community's willingness to accept them. Therefore, we recommend conducting research on the upstream community to facilitate comprehensive planning for future environmental service payments.

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