WILLINGNESS-TO-PAY FOR WATER SERVICE OF PEOPLE IN A COASTAL COMMUNE – A CASE STUDY IN VINH XUAN COMMUNE, PHU VANG DISTRICT, THUA THIEN HUE PROVINCE

Mai Ngoc Chau*, Nguyen Bac Giang

Faculty of Environmental Science, University of Sciences, Hue University
77 Nguyen Hue St., Hue, Viet Nam

*Email: mnchau@hueuni.edu.vn

Received: 25 August 2019; Accepted for publication: 5 April 2020

Abstract. Nowadays, clean water plays a vital role in the life but many inhabitants in Vinh Xuan, a coastal commune (Thua Thien Hue, Viet Nam), are facing the clean water shortages. This paper presents the results of water use situation, Willingness-To-Pay (WTP) and analysis of the factors affecting WTP for water service of residents in Vinh Xuan. The objective of the paper is to evaluate the status of clean water use and people’s awareness through WTP for water service. A survey on water consumption and WTP estimation of users for water service experienced that only one-third of Vinh Xuan people have had access to clean water. This situation illustrated getting access as well as using clean water have been still limited while the demand of water use has been rising. Besides, more than a half of inhabitants in this commune accepted to pay for better water quality and regular water supply even the water price is from 500 to 1,000 VND per m³ higher than the current price. The average WTP was calculated, 8,519 VND per m³ with households using tap water and about 8,750 VND per m³ with non-using-tap-water households, revealing their desire of using tap water. Through interview and regression model, some main factors affecting household’s water using were the awareness of water using, income of residents, etc. Several solutions were proposed to improve the situation of water use and assess people’s awareness through WTP for water service in Vinh Xuan.

Keywords: clean water, households, Vinh Xuan commune, water services, Willingness-To-Pay.

Classification numbers: 3.4.2, 3.8.2.

1. INTRODUCTION

According to statistics results from Thua Thien Hue Province People’s Committee, the proportion of people in Hue city having approached to the clean water was more than 99%; meanwhile, the figure for residents using clean water in rural areas was only about 78% (by 2017) in Thua Thien Hue province, Viet Nam [1, 2]. Most of inhabitants in Hue urban area could easily access to clean water but the people in Hue coastal area have found it difficult to approach this vital water source, especially for those living in Vinh Xuan commune. It is
Willingness-to-pay for water service of people in a coastal commune – a case …

evidenced that only the local people residing in one of six villages in this commune are able to use the clean water [3, 4].

To deal with this problem as well as increase the participation of residents in water management, find out about the habits and the opinions related to water use, WTP for water services is chosen to research. In addition, several studies on WTP for water service were conducted in Vietnam such as those in Ha Noi, 2017 [5], Quang Ninh, 2018 [6], but there were no similar studies in Thua Thien Hue. This paper is necessary to provide information about water service for the government. Thus, the main objective of this paper is to evaluate the status of clean water use and people’s awareness through WTP for water service. In addition, several solutions were proposed to improve water use efficiency and the quality of people’s life in the coastal commune.

2. METHODS

2.1. Study area

Vinh Xuan is a coastal commune in Phu Vang district, Thua Thien Hue province. This commune is located 30 km to the northeast of Hue. It consists of six villages: Xuan Thien Ha, Xuan Thien Thuong, Ke Vo, Tan Sa, Khanh My, and Mai Vinh. The total population of Vinh Xuan commune was 8,862 people with 1,934 households by 2018. Population of this commune is quite young and highly skilled in their work [3].

2.2. Methods

2.2.1. Questionnaire survey

The questionnaires were used for two groups of interviewees including officers, staffs in the local authority and households of six villages in Vinh Xuan. With respect to households, the data was collected relating to the socio-economic aspect (such as ages, gender, how many members in the household, income, etc.) and specialized aspect (such as current situation of domestic water use, water sources, the suitable price of water service on a household level, etc.). The quantity of the questionnaires administered in each village was based on the number of its households that were randomly selected and non-probability sampling, widespread separation in the commune area to ensure representative sampling. The sample size of the study area was determined based on Slovin's formula [7], ensuring a 95 % confidence level of 0.05. The Slovin’s formula is given below:

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

where: n: sample size; N: population size; e: margin of error.

Using the formula (1) with N of 1,934, e of 7.8 %, the result of n was 150. In fact, the percentage of interviewed households was 7.8 % (150 households in total with 1,934 households of which using tap water). Details are shown in Table 1.
Table 1. Detail number of interviewed households in Vinh Xuan.

| No. | Village          | Households | Interviewed households | Percentage of interviewed household |
|-----|------------------|------------|------------------------|-------------------------------------|
| 1   | Xuan Thien Ha    | 706        | 48                     | 6.8%                                |
| 2   | Xuan Thien Thuong| 442        | 34                     | 7.7%                                |
| 3   | Ke Vo            | 170        | 17                     | 10.0%                               |
| 4   | Tan Sa           | 168        | 17                     | 10.1%                               |
| 5   | Khanh My         | 204        | 17                     | 8.3%                                |
| 6   | Mai Vinh         | 244        | 17                     | 7.0%                                |
|     | Total            | 1,934      | 150                    | 7.8%                                |

2.2.2. Data analysis and processing

Information, data from the survey and the local government office were summarized and processed through Microsoft Excel. In particular, Contingent Valuation (CV) method [8,9] were used to calculate the value of WTP for water service with formula (2).

\[ Wtp_{th} = \frac{\sum_{k=1}^{6} wtp_k \times nk}{\sum_{k=1}^{6} nk} \]  

Note: k: the indicator of WTP rate k = 1 ÷ 6; wtpk: the kth WTP rate; nk number of households using tap water or without using tap water corresponding to average wtpk.

In addition, multiple regression was used to determine variety of the factors affecting the desire of local people in paying for clean water service. In particular, some factors affecting Willing-to-pay for clean water service were chosen after comparing the correlation in pairs with the price of water residents have willing to pay. Moreover, based on the theory and relevant knowledge of similar studies [8,9] to select these independent variables. Those factors include age (Age), gender (Gen), income monthly (Inc), the average monthly amount of water using (X), number of people in a household (M). Therefore, the model of WTP is as shown in equation (3).

\[ WTP = C + \beta_1 Age + \beta_2 Gen + \beta_3 Inc + \beta_4 X + \beta_5 M \]  

Note: Age, Gen, Edu, Inc, X, M: symbol of variables was chosen to calculate; C: constant; \( \beta_1, \beta_2, \beta_3, \beta_4, \beta_5 \): intercept of the independent variables.

3. RESULTS AND DISCUSSION

3.1. Water sources and status of water use

As the report of People Committee of Vinh Xuan commune in 2018, the proportion of households using tap water was approximately 33.4%. In daily life, the residents still have used other sources for domestic purpose such as well water, and rainwater even though they have tap water. After the investigation, the households using well water and tap water made up 97.3% while the figure for rainwater was 2.7%. This is a habit to save water of local residents when residents still use rainwater for cleaning house or other purposes.
In addition, some other households were still using bottled water for drinking and cooking purpose. This is due to the fact that the local residents worried about the quality of well water. In term of sensory assessment, 89.6 % residents agreed that the quality of tap water was good for drinking and cooking. In term of well water, 41.2 % respondents answered that the quality of well water was not good for drinking and cooking. More seriously, 10.8 % households cannot use well water for all purposes. From the results of interviewing 150 households, the overall satisfaction with the water quality was 61.3 % and residents were the most satisfied with the quality of tap water. In general, most of people answered the amount of water supply enough for daily activities, even in the dry season.

3.2. Evaluating Willing-to-pay for clean water service

3.2.1. Some information about interviewees

In the survey area, some information collected from interviewers of 150 households were shown. Particularly, the rate of gender was quite equal because of random choice, with 53.4% men and 46.6 % women. In term of age, respondents aged over 30 years old made up the highest proportion, at about 89.9 %. These people have a variety of experiences so the information could be reliability. Concerning the occupation, the major livelihood of residents was farmer, accounting for 51.9 %, and the average amount of water use was 3.1 m³/month. Finally, the average income of interviewed households was 1.3 million VND/month. Income seemed to be a key factor affecting to WTP for clean water services.

3.2.2. Average value of Willing-to-pay for clean water service

The result of household’s WTP for clean water service is calculated based on given equation 2.2, and illustrated in Table 2. The number of households did not employ tap water was 102 out of 150 households. Among them, 85 households agreed with fee for clean water service and the rest of those have no ideas because they had not used tap water yet.

*Table 2. Willingness-to-pay rate of interviewed household.*

| k  | WTPₖ (VND/month) | n₁ₖ (household) | Percentage of n₁ₖ (%) | n₂ₖ (household) | Percentage of n₂ₖ (%) |
|----|------------------|-----------------|-----------------------|-----------------|-----------------------|
| 1  | 8,258            | 21              | 43.8                  | 26              | 30.6                  |
| 2  | 8,500            | 20              | 41.7                  | 30              | 35.3                  |
| 3  | 9,000            | 3               | 6.3                   | 16              | 18.8                  |
| 4  | 9,500            | 3               | 6.3                   | 5               | 5.9                   |
| 5  | 10,000           | 1               | 2.1                   | 3               | 3.5                   |
| 6  | 10,500           | 0               | 43.8                  | 5               | 5.9                   |
|    | Total            | 48              | 100.0                 | 85              | 100.0                 |

WTPₚⱼp (VND/month) | 8,519 | 8,750

*Note:* The price increased by 500 VND continuously. The first point was the current water fee, at 8,258 VND.
A combination of CV method and the data in Table 1 demonstrated that the average WTP was 8,519 VND per m³ with interviewees using tap water and 8,750 VND per m³ with those relying on non-tap water. People, who had not used tap water, were ready to pay 200 VND per m³ higher than those using tap water. This number is estimated for people, who are using well water, rainwater, would like to access tap water. Despite of the small difference in the amount of the money, the figures show how the great demand and desire of using clean water of local people were.

Reasons why interviewees agree or disagree to pay the higher fee for water service were elucidated in Figure 1.

![Figure 1](image)

Figure 1. Reasons to agree (a) (86 responders) or disagree (b) (47 responders) with the higher water service fee.

According to 133 calculated households, there were 86 households ready to pay higher than the current fee (8,258 VND/m³) for clean water service. The remaining responders did not answer because they did not know and had no idea to use tap water. The most common reasons for accepting higher water fee are saving water, following by ensuring health. In term of disagreement for the increasing fee, the most answered reason was the suitability between the current fee and people’s income. It meant they couldn’t afford to pay for the clean water with that water fee.

3.2.3. Determining some factors affecting Willing-to-pay of residents for clean water service

Some factors affecting Willing-to-pay for clean water service were shown in Table 3.

The result of regression indicated that Multiple R for household using and non-using tap water were approximately 0.578 and 0.727 respectively. Besides, F (0.003376) with significance F (1.02 × 10^{-11}) were much smaller than 0.05. These data proved that two chosen regression models were suitable.

With regard to using tap water household

\[
WTP_1 = 8.511 + 6.05 \times 10^{-6} \text{Age} + 0.114 \text{Gen} + 2.81 \times 10^{-4} \text{Inc} - 0.075X - 0.062M
\]

In model, chosen-independent variables explained about 33.4 % related to the fluctuation of dependent variable Y (price level) because R square was equal to 0.334. In term of the explanation for Y, 66.6 % was due to other elements, which did not list in the model.
Willingness-to-pay for water service of people in a coastal commune – a case …

Table 3. Result of regression statistics for WTP of answered household.

| Independent variables | WTP using tap water (WTP₁) | WTP non-using tap water (WTP₂) |
|-----------------------|-----------------------------|-------------------------------|
|                       | Coefficients | P-value  | Coefficients | P-value  |
| Constant              | 8.511        | 4.68 × 10^{-34} | 7.67         | 2.8 × 10^{-39} |
| Age (The age of interviewee) | 6.05 × 10^{-6} | 0.998 | 0.003 | 0.341 |
| Gen (Gender of interviewee, dummy variable: Female is 0, Male is 1) | 0.114 | 0.287 | 0.118 | 0.232 |
| Inc (Income of interviewee, million VND/month) | 2.81 × 10^{-4} | 6.41 × 10^{-4}* | 5.52 × 10^{-4} | 1.32 × 10^{-12}* |
| X (The average of the water consumption per interview person, m³/month) | -0.075 | 0.012* | -0.014 | 0.411 |
| M (Number of people in household) | -0.062 | 0.019* | 0.054 | 0.040* |
| Count (Sample size) | n₁ = 48 | 0.334 | n₂ = 85 | 0.528 |

* is significant because P-value ≤ 0.05.

With regard to non-using tap water household

\[
\text{WTP}_2 = 7.67 + 0.003 \text{Age} + 0.118 \text{Gen} + 5.52 \times 10^{-4} \text{Inc} - 0.014 \text{X} + 0.054 \text{M}
\]

In model, R square was 0.528, which showed that 52.8% chosen-independent variables explained the fluctuation of dependent variable Y and 47.2% was due to other elements that were not inside the model.

Some factors affected WTP of interviewed household

The data in the Table 2 demonstrated that the number of household members, the amount of water use were in inverse proportion to WTP while the age, gender, and monthly average income were directly proportional to WTP. Compared to non-using- tap-water households, only the amount of water use was inversely proportional to WTP.

In both models, P-value of two variables including age and gender were larger than 0.05 so these two variables were not statistically significant to WTP of interviewed households.

Not surprisingly, people who got higher income and used less water for daily life were ready to pay higher for water service. This means when the amount of water use was increasing, WTP for water service will decrease to save water. Similarly, if the number of people in household grow, WTP will go down. This can be explained that the demand of water use will also rise when the number of members in a family increase. In comparison with another research in Chuong My, Ha Noi [5], the income was the most influential factor as well. Similarly, the research in Dong Trieu, Quang Ninh [6] exhibited the income and the amount of water use which were key factors in WTP for water service.

3.3. Forward solutions
Firstly, the authorities should invest comprehensive water supply system for the rest of households in the region as well as guiding, supporting people to treat other water sources before using, especially well water. Interestingly, water co-management could be applied to share the responsibilities between local government and residents to supply water for people when people were willing to pay higher the current price. In other words, increasing water price to help people save water and the additional amount of money could be used to maintain water pipe and the quality of water. Moreover, local people, the majority of farmers might approach to low- interest loans when purchasing machine or technology related to farming. This action will create good opportunity for local people to improve their income, one of the key factors affecting WTP for water service. Final solution is applying some propagandizing such as panel, imparting knowledge via simple stories, or printing some images on water bills to use water efficiently and also create good habits of saving water for community.

4. CONCLUSION

The survey conducted in Vinh Xuan commune with 150 households showed that the rate of households that had not accessed to tap water was 33.4%. Moreover, 52% respondents said that quality of well water was not good for drinking and cooking. According to CV method, the average WTP was calculated. In particular, WTP for household using tap water and not using tap water were 8,519 VND per m$^3$ and 8,750 VND per m$^3$, respectively. After using regression, the income was directly proportional and the amount of water use was inversely proportional to WTP in the both models of household using and not using tap water. Therefore, some solutions were proposed to increase income and enhance knowledge of residents in water-use efficiency.

REFERENCES

1. Chau M. N., Giang N. B. and Harada H. - Household water security of people in Hue suburbs – a case study in Huong Tho commune, Huong Tra district, Thua Thien Hue province, Vietnam Journal of Science and Technology 53 (3A) (2015) 163-168.
2. Nguyễn Minh Trí, Trần Minh Sư - The reality cleaning of living water in some social coastal at Phu Vang district, Thua Thien Hue province. The 2nd National Scienticfic Conference on Biological Research and Teaching in Viet Nam (2016) 1201-1207 (in Vietnamese).
3. Thua Thien Hue Province People’s Committee - Report on Socio-economic Development and Environmental sanitation of Vinh Xuan commune in 2017, 2018 (in Vietnamese).
4. Thua Thien Hue Province People’s Committee - Report on New rural development planning till 2020 in Vinh Xuan commune in 2017 (in Vietnamese).
5. Nguyễn Ba Huan - Estimate of local residents’ willingness to pay for using clean water in Chuong My district, Hanoi, Journal of Forest Science and Technology 1 (1) (2017) 129-139 (in Vietnamese).
6. Hoàng Thị Hue, People’s willingness to pay to improve clean water service in Dong Trieu Commune, Quang Ninh province, the VNU Journal of Science: Earth and Environmental Sciences 34 (3) (2018) 110-119 (in Vietnamese).
7. Consuelo G. S., Jesus A.O, Twila G.P., Bella, P. R., and Gabriel G.U. - Research methods. Rex Printing Company, Inc, 2007.

8. Tussupova K., Berndtsson R., Bramryd T. and Beisenova R. - Investigating Willingness to Pay to Improve Water Supply Services: Application of Contingent Valuation Method, Water 7 (2015) 3025-3038.

9. Wedgwood A., Sansom K. - Willingness-to-pay surveys - A streamlined approach: Guidance notes for small town water services, WEDC, Loughborough University, UK, 2003.