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Understanding Households' Willingness to Pay for Improved Sanitation Services in Benin: A Study Protocol

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ABSTRACT: Nowadays, in Benin, latrine construction by households highly depends on their financial contributions. However, empirical evidence shows that many households are unwilling to invest in adequate sanitation services. The study aims to determine the household's willingness to pay for improved sanitation services and the associated factors. The study population will include households lacking unimproved sanitation facilities. The household heads will be eligible for survey participation. We will perform a contingent valuation to determine households' willingness to pay for a Ventilated Improved Pit (VIP) latrine. Following a description of the surveyed population, we will assess willingness to pay using the 'doubleb' command in Stata. Subsequently, we will conduct multivariate logistic regression to determine the factors associated with willingness to pay. The expected results will be: a description of the basic characteristics of households without improved sanitation services, an estimation of household willingness to pay for VIP latrines using the contingent valuation, and factors associated with household willingness to pay for VIP latrines. This study will contribute to the literature on household demand for improved sanitation services in Benin.

KEYWORDS: Demand, sanitation, VIP latrine, willingness to pay, household, Benin

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Background

The World Health Organization (WHO) defines sanitation as the provision of facilities and services for the safe disposal of human urine and faeces.¹ It includes both the hardware components (such as latrines and sewers) and the software elements (regulations, promotion).² The WHO/UNICEF Joint Monitoring Programme (JMP) establishes a hierarchy of access to sanitation services for households, ranging from the lowest level of 'no service' (open defecation) to the highest level of 'safely managed', with intermediate levels including 'unimproved', 'limited' and 'basic'.³ Globally, the proportion of the world's population with access to basic sanitation services increased during 2000 to 2020, from 59% to 78%.³ However, in 2020, approximately 1.7 billion individuals still lacked adequate sanitation services, of which 494 million (13%) practised open defecation (disposing of human excreta in places other than latrines, such as fields, forests, bushes, water bodies, beaches or other open spaces).³ In Sub-Saharan Africa, despite investments made, the proportion of the population with access to basic sanitation services only increased by 10 percentage points during 2000 to 2020 (from 23% to 33%).³ This situation, partially attributable to uncontrolled population growth (+73%) or the persistence of widespread poverty, makes Sub-Saharan Africa the least-covered region in basic sanitation services in 2020.³

In Benin, the issue of inadequate access to proper sanitation services remains a significant concern, marked by insufficient coverage levels. A study conducted in 2022 revealed that more

than half (54%) of households practised open defecation.⁴ Unimproved, limited and basic sanitation services were observed in 12%, 21% and 13% of households, respectively.⁴ Furthermore, projections based on historical trends suggest that the national coverage of basic sanitation facilities will reach only 26%, with a prevalence of open defecation at 46%.⁵ Besides this insufficient coverage, disparities persist related to household characteristics.⁴ Notably, this situation has implications for the health of the most vulnerable groups, particularly children under 5.^{6,7}

Numerous barriers impede households' proper sanitation services use. Among these, there is insufficient availability of well-maintained, functional sanitation facilities within acceptable proximity to dwellings. While the presence of sanitation facilities in homes does not guarantee their use, their absence is still detrimental and associated with open defecation or, in some cases, sharing with other people.^{8–14} Consequently, enhancing accessible and functional sanitation services availability emerges as a promising strategy to effectively combat open defecation, with a preference for improved services. Improved sanitation services are those designed to prevent human contact with excreta.³ These encompass latrines connected to septic tanks, ventilated improved pit latrines, pit latrines with slabs, composting toilets, manually or mechanically flush toilets connected to sewage networks, and manually and mechanically flush toilets. However, nowadays, in Benin, the construction of latrines by households is heavily reliant on their financial contributions, which, in turn, depend on their



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Willingness To Pay (WTP).¹⁵ Unfortunately, through empirical observation, it is evident that in rural areas of Benin, many households are unwilling to invest in adequate sanitation services. Recent studies in Africa and Asia highlighted several factors associated with households' WTP for sanitation services. The WTP for improved sanitation services appears higher in households led by younger individuals, men and those with higher levels of education compared to older individuals, women and less educated people, respectively.¹⁶⁻²⁰ Certain studies emphasize a negative association between household size and WTP for sanitation services, while others highlight a positive association.¹⁸⁻²¹ Households with favourable economic conditions seem more inclined to pay for sanitation services.^{15,18,19,22}

In the specific context of Benin, limited up-to-date information is available regarding the reasons underlying households' reluctance to pay for improved sanitation services. In response to this, the present work aims to study the WTP for improved sanitation services and the associated factors.

Methods

Study setting

We will conduct the study in the Republic of Benin, a West African country with an area of 114 763 km². Administratively, Benin has 12 departments: Alibori, Atacora, Atlantique, Borgou, Collines, Couffo, Donga, Littoral, Mono, Ouémé, Plateau and Zou, as designated by the legislation numbered 97-028 on January 15, 1999, which pertains to the territorial administration organization.²³ Each department is made up of communes (77 in total), which are divided into arrondissements, which in turn are split into neighbourhoods and villages. Projections from 2021 approximate the Beninese population at 12 535 929 inhabitants.²⁴ Most Beninese live in rural zones, accounting for 58% of women and 57% of men, while urban area accommodates 42% of women and 43% of men.²⁵ With a per capita Gross Domestic Product (GDP) amounting to USD 3505, Benin's positioning stands at the 160th rank on the Human Development Index (HDI) scale, as delineated in the 2022 Human Development Report by the United Nations.²⁶ According to the Harmonized Household Living Conditions Survey of 2019, the national annual poverty threshold was 246 542 West African CFA Francs (F CFA), about 410 United States Dollars (USD).²⁷ This threshold comprises a food component (146 793 F CFA, about 245 USD) and a non-food component (99 749 F CFA, about 165 USD).²⁷ An examination of expenditure patterns among Beninese households indicates that 38.5% of individuals subsist below this poverty threshold.²⁷

Study population

We will include households that do not have improved sanitation facilities and have been living in their dwelling for at least

6 months. Households whose heads are not available or do not give their consent to participate will not be included.

Sampling strategy

We will utilize a multi-stage random sampling approach to select participants for the study. In this approach, we will categorize the national territory into 3 zones based on the geographical arrangement of the 12 administrative departments: South (including Littoral, Atlantique, Mono and Ouémé), Central (including Zou, Collines, Plateaux and Couffo), and North (including Atacora, Donga, Borgou and Alibori). From each of these regions, we will randomly select 1 department (from the set of 4) using a simple random sampling method. Within each of the 3 previously selected departments, we will randomly choose a commune, within which an arrondissement will also be randomly selected. Among the arrondissements ultimately selected, all neighbourhoods or villages will be eligible for inclusion in the survey. The surveyors will start from an intersection point at the centre of the neighbourhood or village. The surveyors will randomly determine a direction by tossing a pen into the air and following the direction indicated by the pen's tip. The surveyors will adhere to a step size of 2, meaning they will visit the second house on the right first, followed by the fourth, the sixth and so on. In cases where multiple households are within a single dwelling, the surveyors will randomly select and include only one. The surveyors will choose the opposite side if any house is on the right. If the number of households is less than required, they will return to the centre and choose another direction. They will then apply the same selection protocol again. The required number of participants per neighbourhood or village is determined proportionally based on their size from the General Population and Housing Census IV. We will consider the household head as eligible for the survey. The minimum sample size, calculated using the Schwartz formula with a prevalence of 50%, a margin of error of 5%, a precision level of 5%, a cluster effect of 1.5 and a 10% inflation factor, will be 634.²⁸

Dependent variable

We will examine the households' WTP for improved sanitation services, focussing on Ventilated Improved Pit (VIP) latrines. A VIP latrine is a dry pit latrine consisting of a pit, a superstructure or shelter and a ventilation pipe.^{29,30} It is like an upgraded version of a simple pit latrine. The concept aims to mitigate or eliminate nuisances such as odours and fly presence associated with simple pit latrines.^{29,30} It involves installing a vertical ventilation pipe with a fly screen at the top.^{29,30} When the wind blows over the pipe's top, it generates an upward airflow between the pit and the external environment, concurrently with a downward airflow between the toilet structure and the pit through the defecation opening.^{29,30}

We will perform a contingent valuation to analyse households' demand for VIP latrines. This method involves soliciting a group of individuals for their WTP for a specified good or service, in this case, a VIP latrine. Generally, there are 3 ways to elicit WTP using contingent valuation. The first approach involves payment card use; individuals receive a series of amounts and select the one closest to their WTP entails an open-ended question where participants are asked the amount they would be willing to pay for a hypothetical good or service. The last one employs a dichotomous question, with or without follow-up. Without follow-up, each individual provides limited information about their WTP.³¹ It implies that relatively large samples are necessary for accurate WTP estimates.³¹ An alternative for enhancing estimation accuracy involves posing a follow-up dichotomous question after the initial one. If an individual responds 'Yes' to the first question, their WTP for a higher amount is queried. If the reply is negative, a lower amount would be quoted. This method generates 2 answers for each individual, providing more information.³¹ In the context of this study, the initial question will be: Would you be willing to pay 100 000 F CFA (about 166 USD) to equip yourself with a VIP latrine? This amount was chosen by consensus among the authors. The follow-up question amount is adjusted based on the responses provided by the respondents. If the response to the initial offer amount is 'Yes', the subsequent amount will be increased by 50%. If respondents answered 'No' to the initial offer amount, we would reduce the following offer amount by 50%. Consequently, households' WTP will take the value 'Yes = 1' in case of a positive response to either of the 2 preceding questions and 'No = 0' otherwise.

Independent variables

The independent variables identified through a literature review include the following^{15-22,32,33}: age, sex, level of education, marital status, ethnicity, religion, occupation, knowledge about WASH (Water, Sanitation and Hygiene), exposure level to newspapers, exposure level to radio, exposure level to television, household's wealth index, household's water service, household's hand hygiene service, household size, presence of children under 5 (Supplemental Table S1). The wealth index involves scores for each household based on the quantity and type of consumer goods owned. These scores are derived using principal component analysis. The economic well-being terciles are established by dividing the distribution into 3 equal categories, each representing one-third of the population. We will assess knowledge level based on some questions. For each question, we will assign 1 for a correct answer and 0 otherwise. The total score obtained by each target will be reported as a percentage of the expected total score. Knowledge will be classified as 'Insufficient' if the previous ratio is less than 60%, 'Moderate' from 60% to 79% and 'Sufficient' if it is 80% or higher. The categories used for household's drinking water (basic, limited, unimproved, no service) and hygiene services

(basic, limited, no service) are based on service ladders of the World Health Organization and United Nations Children's Fund (WHO/UNICEF) Joint Monitoring Programme (JMP) for Water Supply, Sanitation and Hygiene. In the Supplemental Materials, we have included a table that defines each category of household's drinking water and hygiene services.

Data collection

Data will be collected using a questionnaire. Given the study variables, the questionnaire will cover 3 parts: section 1 on basic household characteristics, section 2 on WASH and section 3 on WTP. The questionnaire will be digitized using KoboToolbox. Data collectors and supervisors will receive a 1-day training session that will include modules on the following points: data collection process, interview techniques and ethical aspects. The data collection tool will be pre-tested in 30 households not included in the study. Modifications and experience gained from the pre-tested questionnaires will be used to produce the final questionnaire. We will ensure the quality of the data through close supervision, cross-checking of the questionnaires completed daily, editing, coding and data auditing.

Data analysis

We will conduct all analyses using Stata 15, taking into consideration the sampling design. We will describe the independent variables using frequency counts and percentages of their categories. To estimate the WTP, the '*doublet*' command in Stata will be employed.³⁴ Subsequently, we will perform a multivariate logistic regression to identify factors influencing WTP. The dependent variable in this context will assign a value of 1 in case of a positive response to at least one of the contingent valuation questions, and 0 otherwise. The potential factors will be selected at the 20% significance level using simple logistic regression. They will then be introduced into a multiple regression using a stepwise descending strategy to obtain adjusted estimates. The significance level will be set at 5%. We will present results as crude and adjusted Odds Ratios (OR) with their corresponding 95% Confidence Intervals (CI).

Ethical considerations

The study will be conducted according to the Declaration of Helsinki guidelines. We will request informed consent from eligible respondents before commencing interviews. Before, we will provide an information sheet for each potential participant. This information sheet will detail the study's objectives, participation criteria, anticipated interview duration, potential benefits and risks. In the consent form, which will be read to and signed by the respondents, it will be emphasized that they have the right to cease answering questions at any point if they wish, and data will be collected and processed anonymously.

Results

The expected outputs will be:

- Description of the basic characteristics of households without improved sanitation services,
- Estimation of household willingness to pay for VIP latrines using the contingent valuation,
- Identification of factors associated with household willingness to pay for VIP latrines.

Discussion

Although the percentage of households with adequate sanitation services has significantly increased in recent years, the current levels remain insufficient. It underscores the need to enhance efforts at various levels to enable households to access these services. Furthermore, given that household-led construction of latrines heavily relies on their financial contributions, this study aims to understand household demand for improved sanitation services, particularly VIP latrines.

The study population will consist of households without improved sanitation services residing in their dwelling for at least 6 months. The household head is the informed person for the survey because this member (within a household) holds the primary economic power. It will allow obtaining relevant answers regarding the household's capacity to invest money in a good intended to enhance their sanitation level. Four hundred twenty-five individuals are expected for the survey. Some households will be selected in the southern part of the country, others in the central region and others in the northern. It will enable the estimation of household WTP for improved sanitation services depending on their residential environment. A recent study highlighted a gradient in coverage of households by adequate services based on the residence area.⁴ Overall, there was a decrease in the coverage of households with basic sanitation services as one moved toward the departments in the North.⁴

After this study, one expected outcome will be the determination of the WTP for acquiring a VIP latrine, expressed in monetary units. The choice was made for the VIP latrine because it is an improved latrine designed to prevent user contact with excreta. Moreover, such an installation does not require water for its operation, and the materials for its construction are locally available. Denoting \hat{P}_{mW} as the median WTP means that 50% of the surveyed household heads (or representatives) would be willing to pay that amount to have VIP latrines. Furthermore, denotes \hat{P} the market price of a VIP latrine, implementing a subsidy mechanism amounting to $\frac{\hat{P} - \hat{P}_{mW}}{\hat{P}}$ could be associated with a 50% increase in coverage of improved toilets among households currently lacking such facilities. Hence, one of the purposes of this study is to contribute to an appropriate reorganization of the resources invested in promoting basic sanitation in Benin. In this study, we will perform a contingent valuation to determine the WTP.

This method has some limitations that can lead to an overestimation of WTP. The hypothetical nature of the questionnaire can encourage surveyed individuals to overestimate their capacity compared to a real situation.³⁵ Another bias can arise from the fact that the interviewed person might declare a higher WTP to please the interviewer.³⁵ In the literature, several authors have also worked on the demand for sanitation services by households through contingent analysis. Similar to the present study, several authors have adopted a dichotomous approach with some variations.^{16,17,19,22,32,33}

Another expected result of this study will be identifying factors associated with WTP for VIP latrines. Review literature reveals several factors influencing household WTP for improved sanitation services: age, sex, education level, household size, wealth index, etc.^{15-22,33} Are the WTP-associated factors observed in other contexts similar to those recorded in the Beninese context?

Conclusion

This study will contribute to the literature on household WTP for improved sanitation services. The results will document, among other things, the current willingness of uncovered households to invest in adequate sanitation services. Additionally, the study aims to determine the factors associated with this WTP. By studying and identifying these factors, the research provides valuable insights to researchers, policymakers and organizations about the motivations and obstacles influencing households' decisions to invest in better sanitation facilities.

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Author Contributions

All the authors contributed to the conceptualisation of the study. NG worked on the methodology, and AK and CD supervised. NG wrote the first draft of the manuscript. NG, CD, AK, YGA and MP critically revised, commented on and approved the current version of the manuscript.

Availability of Data and Material

The materials for this study (questionnaire) will be available from the corresponding author.


Consent for Publication

Not applicable.

Ethical Standards Disclosure

The study will be conducted in accordance with the guidelines of the Declaration of Helsinki. The protocol will be submitted to the National Ethics Committee for Health Research for approval. We will obtain informed consent from eligible respondents prior to the interviews. Beforehand, we will provide each potential participant with an information sheet.

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Supplemental Material

Supplemental material for this article is available online.

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