World Journal of Public Health
2023; 8(4): 305-309
http://www.sciencepublishinggroup.com/j/wjph
doi: 10.11648/j.wjph.20230804.18
ISSN: 2637-6040 (Print); ISSN: 2637-6059 (Online)

Adoption of Sanitation Technologies in Tana Delta Sub-County, Kenya: The Environmental Factors' Influence

John Dhadho[1], Isaac Okeyo[2]

[1]Faculty of Health Sciences, Great Lakes University of Kisumu, Kisumu, Kenya
[2]School of Health and Biomedical Sciences, The Technical University of Kenya, Nairobi, Kenya

Email address:
jekdhadho@gmail.com (John Dhadho), isaacokeyo@tukenya.ac.ke (Isaac Okeyo)

To cite this article:
John Dhadho, Isaac Okeyo. (2023). Adoption of Sanitation Technologies in Tana Delta Sub-County, Kenya: The Environmental Factors' Influence. *World Journal of Public Health*, *8*(4), 305-309. https://doi.org/10.11648/j.wjph.20230804.18

Received: November 12, 2023; **Accepted**: December 1, 2023; **Published**: December 11, 2023

Abstract: Poor use of sanitation technologies is a widespread health and environmental hazard in many developing countries. Globally, 2.5 billion people do not use sanitation technologies while in Sub-Saharan Africa, about 34% of the population lack sanitation technologies. In Kenya, over five million people are forced to resort to open defecation due to lack of latrines resulting in the prevalence of hygiene and sanitation related diseases such as diarrhea. The study's main objective was to assess factors influencing adoption of sanitation technologies, targeting households in Tana Delta Sub- County of Tana River County, Kenya. A community based Cross-sectional analytical study design was utilized for the study. Tana Delta Sub County was purposively selected based on its low latrine coverage and frequent outbreaks of diarrhea. The sample size was determined based on sample size calculation for single population. Quantitative data was collected from 385households. Qualitative data was collected through Key Informant Interviews to complement the household survey findings. Data was analyzed using quantitative methods (aided by SPSS, 22) and qualitative methods (aided by NVIVO). Data was analyzed both quantitatively and qualitatively and are presented in graphs and Tables. The study established that less than half (41%) of the households in the study area used sanitation technologies. The study also established that environmental factors influencing adoption of sanitation technologies included flooding, topography, soil type, lack of materials as well as having bushes around ($p<0.05$). Also, the study established that demographic factors influence adoption of sanitation technologies in the study area. Further, the study established that economic factors including income and employment status influenced adoption of sanitation technologies. Finally, the study established that cultural factors influenced adoption of sanitation technologies and more specifically construction and use of sanitation technologies in the study area. Recommendations are made for future studies on the extent of influence of sanitation programs in the area, implementation of policies and programs to address low adoption of sanitation technologies in the area.

Keywords: Sanitation, Technologies, Environmental Factors

1. Introduction

Sanitation technologies refer to ways and methods of ensuring provision of clean drinking water, safe human fecal matter and adequate sewage disposal. A sustainable sanitation technology protects human health and does not contribute to environmental degradation or depletion of resource base [4]. The World Health Organization and United Nations Children's Fund called for promoting improved sanitation instead of simple latrines in 2004 [7]. By 2010, many developing countries had large populations with limited access to improved sanitation technologies [6].

According to 2012 estimates, approximately 89% of the global population had access to an improved water source [3]. However, most of the countries in Sub Saharan Africa are not on track to meet MDG targets [8]. Only 64% of the world's population has access to improved sanitation – far below what was targeted in the MDG target of 75% by the year 2015. Progress against sanitation targets has been particularly slow in Sub-Saharan Africa and South Asia [1]. In Kenya for example, only 23% of the population have an improved toilet facility that is not shared with other households even though over 70% have access to an

improved source of drinking water [9]. There is no clear understanding whether and under what circumstances improved sanitation technologies receive public acceptance. Use of sanitation technologies therefore remains central in the post-2015 development agenda [5]. Global diarrhea-related mortality in children under five years of age remains a major justification for investment in sanitation interventions, despite recent declines to an estimated 700,000 deaths in 2011 [7]. Improvements in water quality, sanitation and handwashing are associated with 15-40% reductions in the risk of diarrhea among children under the age of five [1]. The impacts of inadequate water and sanitation are particularly pronounced for women and girls. Hand washing with soap, can play a key role in the response to epidemics of cholera and dysentery in rural populations, reduction in neonatal infections and maternal infections [1], and control of pandemic influenza [2].

Water treatment interventions such as ceramic filters can reduce exposure not only to fecal pathogens, but also to heavy metals such as arsenic, iron and fluoride which in many areas will result into droughts and floods [10]. This may make it necessary for people to rely increasingly on groundwater instead of surface water during dry periods, and to filter this water to remove heavy metals [3]. Construction of wells-to-tap groundwater and promotion of water filters thus may be a key component of climate change adaptation plans in many settings [3].

2. Methods

2.1. Study Design

The study adopted cross-sectional analytical community-based study design and utilized both quantitative and qualitative data collection methods.

2.2. Study Area

The study was conducted in Tana Delta Sub- County of Tana River County. Tan Delta has some of its areas as semi-arid and being inhabited by both farmers and pastoralist communities. The Sub- County is divided into 6 Wards, namely, Kipin East, Kipini West, Garsen South, Garsen West, Garsen North and Garsen Central. The infrastructural development in terms of water distribution, sewerage systems, waste disposal and sanitation are either poor, inadequate or lacking particularly in the villages, unlike in the trading centers like Garsen, which is the seat of the Sub- County government.

2.3. Study Population

The study population consisted of adults aged between 18-49 residing in Tana Delta Sub-County. The Sub-County is divided into three Divisions. Household heads, either mother or father were interviewed. In case of absence of the mother or the father, one present adult represented them in the interview. The study also involved Community Health Assistants and Public Health Officers in the region. Tana Delta Sub-County has about 37489 households [9].

2.4. Sample Size

The sample size was determined based on sample size calculation for single population.

$$n = Z^2 (p\ q)/e^2,$$

Where

n= desired sample size.

Z = standard normal deviate at 95% confidence level (1.96)

P = proportion of the household's target population with hygiene and sanitation facilities 22% (Tana River County Website, 2017).

q = 100 - P

e = degree of accuracy desired (0.05)

$n = 1.96^2 (0.22) (0.78)/0.05^2$

The total of 385 households were targeted for the study after addition of 10% non-response rate. Further, 10 Health Officers including the County and Sub- County level were sampled as Key Informants.

2.5. Sampling Procedure

The study used the 2005 WHO EPI cluster sampling method which provided guidance on conducting high quality cluster surveys for measuring coverage for health interventions. It also provided guidance for identifying the starting and subsequent household. A random sampling technique was then employed to select 385 households from 65clusters of households. According to WHO 21 EPI cluster sampling method the first household was selected by locating approximate geographic center in each selected village and one direction from the Centre chosen using random number table by identifying all possible directions. The next step involved counting all households from the Centre of the area to the edge of the area. A number between one and the total number of households counted was then randomly picked which became the first household to visit. The subsequent households were selected according to the inclusion criteria based on the principle of the next nearest household until the desired sample size was attained.

2.6. Piloting of the Instrument

10 questionnaires were administered to a section of the target population. Their responses were then assessed to determine whether they provide the actual information as anticipated. The results were then used to improve the research instrument and the responses got used to further define the questions used in order to make sure that the information sought are realized using the research instrument. Once the results were received and analyzed, improvement was done. The entire data collection process was then rolled out.

2.7. Validity of Instruments Used

To check the validity of the instrument the researcher

worked with the supervisor as the expert. All the study tools were vigorously reviewed to ensure validity. The study tools were also subjected to peer review to ensure its validity.

2.8. Reliability of the Instrument Used

Inter-item reliability test was applied to test the reliability of the research instrument. Multiple items were used to measure a single concept in the questionnaire. This involved a set of related questions which were designed to measure a certain concept in the study.

2.9. Data Collection Tools

The study used both standard questionnaires adapted and modified from Kenyan EPI Survey of 2014, DHS and other previous studies questionnaires as well as Key Informant Interview (KII) guides. The tools were translated into Kiswahili and translated back to English for consistency. The tools covered all the variables under study. Respondents who were not available during the first visit were revisited within the day or during the interviewer's stay in the area.

2.10. Data Quality Control

Before data collection, the interview Questionnaire were translated from English to Kiswahili and then back to English. The questionnaire and key informant guide were pre-tested before the actual data collection days on 5% households in one of the Sub-Counties. Moreover, Data Collectors and Supervisors were trained for two days. Every questionnaire was checked before data entry.

2.11. Data Processing and Analysis

Quantitative data were coded and analyzed using SPSS version 22 for Windows. Summary statistics such as, percentages and graphical techniques was used. Bivariate analysis was done to test the association between the independent and the outcome variables. All explanatory variables that were associated with the outcome variable in bivariate analyses were included into multivariate logistic regression, to determine factors that are significantly influencing adoption of sanitation technologies. P-value of 0.05 was considered as a cut-off point for statistical significance. Qualitative data was audio recorded and transcribed before analysis. All qualitative data were analyzed thematically and was aided by a computer software (NVIVO). The unit of analysis for the study was the household.

3. Results

Environmental factors investigated included climatic conditions, Soil type, topography, availability of materials and landscape. Chi square test were conducted to establish associated between reported demographic factors and adoption of sanitation technologies. Table 1 below presents the environmental factors associated with adoption of sanitation technologies.

Table 1. *Environmental factors influencing adoption of sanitation technologies.*

Non Users					Users	P-value
Frequent Flooding influence use of sanitation technologies	Yes	270 (70.1)	197	73	1	0.0001
	No	115 (29.9)	31	84	7.3 (4.47,11.96)	
Land is tilted and thus not easy to construct latrines	Yes	220 (57.1)	156	64	1	0.0003
	No	165 (42.9)	72	93	3.1 (2.06,4.81)	
The type of soil in the place of residence makes it difficult to construct latrines	Yes	204 (53.0)	133	71	1	0.0113
	No	181 (47.0)	95	86	1.7 (1.13,2.56)	
There are no locally available materials to construct sanitation facilities	Yes	205 (53.2)	137	68	1	0.0012
	No	180 (46.8)	91	89	2.0 (1.30,2.98)	
There are bushes around which could still serve the same purpose	Yes	204 (53.0)	134	70	1.8 (1.18,2.67)	0.0061
	No	181 (47.0)	94	87		

As presented in table 1 above, Environmental factors associated with adoption of sanitation technologies included Flooding, topography, soil type, lack of materials as well as having bushes around ($p<0.04$). Where frequent flooding was perceived to influence use of sanitation technologies, respondents were 7.3 times less likely to use sanitation technologies. An understanding that tilted land posed a challenge in constructing latrines increased the risk of not using sanitation technologies by 3.1 times. Similarly, respondents who indicated that soil type makes it difficult to construct latrines were 1.7 times less likely to use sanitation technologies and where lack of materials for construction of latrines was cited, respondents were 2 times less likely to use sanitation technologies. Finally, respondents who indicated that bushes around could be used as a substitute for sanitation facilities were 1.8 times less likely to use sanitation technologies.

During the Key informant interviews, it emerged that most of the land occupied by the population at the study area do not support growth of tree which could be used for construction of latrines, has poor soil profile and that frequent flooding was a major factor which made adoption of sanitation technologies difficult.

Regression analysis was also conducted to ascertain the overall influence of environmental factors on use of sanitation technologies.

Table 2 below presents the findings.

Table 2. *Influence of environmental factors on use sanitation technologies.*

ANOVA								
	df	**R Square**	***MS***	***F***	***Significance e F***	**t Stat**	**P value**	**Adjusted d R Square**
Regression n	1	0.55040496 6	527.563 2	9.79379 1	0.014026	15.2358 3	0.001	0.49420 6
Residual	8							
Total	9							

As indicated in Table 2 above, environmental factors significantly influence use of sanitation technologies (p=0.001). The t statistics obtained was 15.23583 with an adjusted R Square of 0.494206. This indicates a positive relationship between environmental factors and use of sanitation technologies.

4. Discussion

The study established that environmental factors influencing adoption of sanitation technologies included Flooding, topography, soil type, lack of materials as well as having bushes around. The study area has been occasioned by frequent floods and unfavorable topographic features. The area is described as prone to floods and the soil topography presents challenges for natural resource utilization [9]. It can thus be reasoned that such challenges in the environment also present a challenge in utilization of sanitation technologies in the study area.

These findings lead to an understanding that environmental factors influence adoption of sanitation technologies in the study are. The findings are in consistence with [7] which provides that seasonal changes marked by changes in weather, ecology and hours of daylight may shape when and how sanitation technologies are accepted. Further, a study conducted by Aledort et al, [2] revealed that most infectious diseases flourish during the wet months of the year; while human activities in a context of constrained choices in life exacerbate the effects of seasons on human health.

5. Conclusion

The study concludes that less than half of the households in the study area used sanitation technologies. Environmental factors influencing adoption of sanitation technologies in the study area included flooding, topography, soil type, lack of materials as well as presence of bushy environment in Tana Delta.

6. Recommendations

The study revealed that most households did not use sanitation technologies in the area and that the situation was influenced by demographic factors, environmental factors, economic factors and cultural factors. Based on such, the study recommends further research with an aim of understanding the extent of influence of available programs in the study area with respect to their contribution to sanitation technology adoption. The study also recommends community engagement techniques with an aim of addressing the cultural issues influencing adoption of sanitation technologies in the study area. Such drives could be organized by the county government and other development organizations in the area. Further, economic factors influencing adoption of sanitation technologies could be addressed through economic empowerment drives and sanitation technology transfer programs in the area. Such could be organized by the government as well as other development partners. For policies, the government should ensure that public health policies relating to sanitation and hygiene are implemented in the area.

Conflicts of Interest

The authors declare no conflicts of interest**.**

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