EFFECTS OF SOCIO-ECONOMIC FACTORS ON HOUSEHOLD UTILIZATION OF IMPROVED SANITATION FACILITIES IN KENYA

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ESTHER NYAMUSI ERYKA

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A Thesis Report Submitted to the School of Economics in Partial Fulfilment of the Requirement for the Degree of Masters of Science in Health Economics and Policy

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STUDENT'S DECLARATION

I, the undersigned, declare that is my original work not submitted to any other institution, or university other than the University of Nairobi for academic credit.

Signed _____ Date 14.12.2021

Esther Eryka Nyamusi (X53/85328/2016)

This proposal has been presented for examination with my approval as the appointed supervisor.

Signed _____ Date 14/12/2021

Dr. Michael Ndwiga

ABSTRACT

Realization of ODF communities and progression on the sanitation ladder to 100% utilization of improved sanitation facilities has become an elusive goal for the WaSH sector both globally and in Kenya. The development WaSH sector has engaged governments in the last two decades in developing various strategic frameworks in a bid to achieve the Millennium Development Goals of 2015 and the Sustainable Development goals of 2030 for sanitation. Additionally, research studies have developed theoretical models and descriptive frameworks that endeavor to guide behavior change interventions related to sanitation. Kenya is among countries that have integrated the development goals in its sanitation strategic frameworks however; the country's OD rate stands at 14% with an annual decline rate of 0.75%, while the rate of uptake of improved sanitation facilities is at 1%. This research study aimed to determine the effects of socioeconomic factors on utilization of improved sanitation facilities by households in Kenya. It followed the Integrated Behavior Model for Water Sanitation and hygiene and, employed probit model in analysis of the 2018 Kenya Integrated Budget Household Survey data to determine the effects of income, education level, gender and age on utilization of improved sanitation facilities by households in Kenya.

The study applied probit model. The study findings indicate, the type of sanitation facility utilized by a household is determined by, the sex of the household head, the highest level of education attained by the household head and, the household income.

The study concludes that sanitation policy formulation and implementation should target resources towards knowledge empowerment and increasing household income generating streams for investment in improved sanitation.

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LIST OF ABBREVIATIONS

CLTS	Community Led Total Sanitation
FOAM	Focus Opportunity Ability Motivation
GDP	Gross Domestic Product
GSF	Global Sanitation Fund
IBM-WaSH	Integrated Behavioral Model -Water, Sanitation and Hygiene
IFC,	International Finance Corporation
JMP,	Joint Monitoring Program
KEMSA	Kenya Medical Supplies Authority
KESSF	Kenya Environmental Sanitation and Hygiene Strategic Framework
KIHBS	Kenya Integrated Household Budget Survey
KNBS,	Kenya National Bureau of Statistics
LMIC	Low Middle Income Country
MDG	Millennium Development Goals
MOW	Ministry of Water
MWI,	Ministry of Water Irrigation
NASSEP	National Sample Survey and Evaluation Program
OD	Open Defecation
ODF	Open Defecation Free
PPIP-WSS	Pro-Poor Implementation plan for Water Supply and Sanitation
RANAS	Risks Attitude Norms Abilities Self-regulating
SDG	Sustainable Development Goals
SSA	Sub Saharan Africa
UN	United Nations
UNICEF	United Nations Children's Fund
USAID	United States Agency for International Development
USD	United State Dollar
VIF	Variance Inflation Factor
VIP	Ventilated Improved Pit

WHO	World Health Organization
WSP	Water Sanitation Program
WSSCC	Water Supply and Sanitation Collaborative Council
WSUP	Water Sanitation Urban Program
WTP	Willingness to Pay

CHAPTER ONE

INTRODUCTION

1.0 Introduction

Sanitation is a key driver to achieving sustainable development goals; Provision of quality sanitation to a rapidly growing population especially in the Low Middle Income Countries has become a global challenge and therefore a high priority agenda in global development forums and discussions. Currently 700 million urban residents globally, have no access to improved sanitation, with 80 million practicing open defecation (Anderson, Dickin, & Rosemarin, 2016; WHO|UNICEF- JMP, 2012).

One of the key action points for Sustainable Development Goal target 6.2 is to achieve an Open Defecation Free (ODF) environment by 2030 (United Nations, 2015). According to Joint Monitoring Program, an ODF environment ensures excreta disposal is done in toilets rather than in open spaces, this reduces pollution of water, soil and air; it is therefore an important element in ensuring environmental sustainability; target 1 for Sustainable Development Goal (SDG) 14 (United Nations, 2015; WHOUNICEF-JMP, 2017). An ODF environment also is a key output for measuring outcomes of sanitation and hygiene interventions and therefore a key indicator for attainment of access to basic services to all and, upgrade of informal settlements as outlined in SDG 11 target 1 (United Nations, 2015). Attaining ODF environment is vital in achieving Sustainable Development Goal 3 target 3 that aims at eliminating water borne diseases and, target 9 of the same goal which aims at substantially reducing the number of deaths and illnesses due to water and soil pollution by 2030 (United Nations, 2015).

1.1 Background of study

Open defecation has continued to be a major global concern. The gravity of its negative effects on health and development has placed it as one of the most important global agenda in both political and development forums. A 2018 World Bank study put at 68% the population with access to improved sanitation facilities globally with the high- income countries reporting between 99% to 100% access to improved sanitation facilities while only 27% of the population in the low middle-income countries (LMIC) had access to improved sanitation facilities (Cole, 2018). Communities in the rural regions within the LMICs accounted for 70% of the population without basic sanitation with 90% of them still practicing open defecation (Cole, 2018).

Year 2015 data from Joint Monitoring Program indicated 87 % of China's population had access to improved sanitation facilities while, Low Middle Income Countries in South America inclusive of Venezuela, Costa Rica, Cuba and, Sri Lanka recorded 95% improved sanitation coverage in the same year (WHO|UNICEF-JMP, 2015). In contrast, during the same period, a dismal 28% of the population in Sub Saharan Africa had access to basic sanitation facilities and, 17.9 %, had access to limited sanitation facilities, shared by several households (WHO|UNICEF-JMP, 2015). Democratic Republic of Congo, Ghana and South Sudan reported grim improvement in sanitation coverage rates at 20%, 20% and, 16% respectively (Cole, 2018). The Joint Monitoring Program put Kenya overall sanitation coverage at 31%. 8 million Kenyans still defecate in the open and only 16% of child fecal waste is disposed in safe and improved sanitation facilities (Mansour, Oyaya, & Owor, 2017).

The UN-Habitat Slum Almanac 2015/2016 report put at 30% the population in Kenya with access to improved sanitation by the year 2012, with 6 million still practicing open defecation this, excluded sanitation practices for young children (WSP; UNICEF, 2015). Kenya has a low uptake rate for improved sanitation, with a 4% increase in population access to these facilities between 1990 and 2013 and 0.2% increase in household access between 2009 and 2015 (Mule et. al, 2016; Development Initiatives, 2018). By 2016, a massive 76% of Kenyan households either used unimproved sanitation facilities or practiced open defecation contrary to the millennium development goal that aimed at ensuring 76% of the population had access to improved sanitation facilities (Mose, 2018). In the same year, half the number of households in 26 counties accessed basic sanitation. Only six counties had 90% household coverage of improved sanitation; four of them specifically Embu, Taita Taveta, Embu and Kisumu had 96% of households accessing improved sanitation (Mose, 2018; Development Initiatives, 2018).

1.1.1 Causes of Poor Fecal Waste Disposal

In 2012, The World Health Organization indicated that poor sanitation cost countries up to 7.2% of their annual GDP due to death and illnesses related to poor sanitation, loss of productivity time in illness and in seeking treatment (WHO|UNICEF- JMP, 2012). There has been a global decline in the rates of open defecation with numbers of populations still practicing it dropping from 1229 million in the year 2000 to 892 million in 2015 (WHO|UNICEF- JMP, 2017). Recent statistics by WHO indicate a further drop in open defecation to 673 million in 2017 (WHO|UNICEF- JMP,

2019). On the contrary, Sub Saharan Africa has seen increase in open defecation from 204 million to 220 million attributable to rapid population growth in the region (WHO|UNICEF-JMP, 2015). Eritrea at 76%, Niger at 71%, Chad at 68% and South Sudan at 61% are countries with highest rates of open defecation. Poor fecal waste disposal has affected negatively on population health in these countries with each of them experiencing high morbidity and child mortality rates due to diarrhea, worm infestation and bacterial infection (Cole, 2018).

A study on Kenya Demographic Health Survey data for 2003, 2008 and 2014 established the annual rate of decline of open defecation among the poorest to be at 1%. The study further indicated a disparity in open defecation across wealth quantiles with 46% of the poorest practicing open defecation against 0% of the richest (Njuguna & Muruka, 2019). According to Pascaline Ndungu in her World Bank blog, 15% of the rural population and 3% of the urban population continue to practice open defecation, due to rapid population growth, it is imperative to focus on the absolute numbers to appreciate the magnitude of Open defecation (Ndung'u, 2018). The causes of poor sanitation and persistent practice in open defecation vary across regions, populations and households based on the demographic, socio economic, behavioral and cultural characteristics.

Lack of robust sanitation infrastructure due to poor urban planning in major cities in the LMICs, where most informal settlements develop prior to installation of basic sanitation infrastructure has seen untreated human excreta released into the environment (Schreconogost & Wong, 2015). Additionally, insecure land tenure and unstructured mode of payment for utilities in urban informal settlement has seen providers prioritize utility provision to formal urban communities (Schreconogost & Wong, 2015). Cole (2018) indicates that well planned, well managed and well maintained sanitation infrastructure yields both health and economic benefits; for instance, improved sewer systems has reduced prevalence for diarrheal diseases to 20% in El Salvador, while in India it saves the country up to $54 billion annually. Proximity to sanitary facilities affects individual use of latrines. Limited number of latrines or their absence in urban informal settlement and the rural areas, increase the probability of individuals use of rudimentary forms of sanitation or to defecate in the open (O' Conell, 2014).

In Tanzania, latrine ownership is categorized as a low priority need in the hierarchy of expenditure especially in poor households (Sara & Graham, 2014). The perceived high cost of repair and maintenance of latrine is also a barrier to individual’s latrine ownership in the urban settlement

and rural regions therefore contributes to persistence in open defecation (Sara & Graham, 2014). A majority of open defecator cite absence of building expertise to construct quality latrines as a major setback to owning and using one (O' Conell, 2014).

The situation replicates in Kenya, where poverty is the lead cause of OD with 60% of the poorest wealth quintile practicing OD in comparison to less than 1% of the richest quintile; the poor households attribute financial constraint as barrier to investing in improved sanitation facilities (Mule et.al, 2016; Development Initiatives, 2018). Disparities in the OD rates in Kenya further repeats itself across counties, with the poorest counties that are habitation of nomadic communities presenting with the highest OD rates, credited to inequity in allocation of resources for sanitation and their lifestyle (Development Initiatives, 2018; Mule et.al, 2016; Njuguna & Muruka, 2019). Poor planning, unclear land ownership and, insecure land tenure impede investment in sanitation infrastructure in Kenya's urban informal settlements characteristically inhabited by the poor who consequently, resort to postponed OD otherwise known as 'flying toilets' (Development Initiatives, 2018; Mansour, Oyaya, & Owor, 2017).

1.1.2 Strategies to Address Poor Fecal Waste Disposal

Millennium Development Goal 7 target C aimed at reducing by half the population of people living without access to basic sanitation by 2015. The Millennium Development Goals assessment report for 2015; indicated a 50% decline in the proportion of population practicing open defecation between 1990 and 2014 (Harrigan & Birch, 2015). The Sustainable Development Goal 6 target 2 seeks to ensure equitable access to sanitation by all and eliminate open defecation by 2030 (United Nations, 2015). Various strategies are being implemented globally and regionally to achieve this Goal. The United Nations underscores sanitation as the key driver to achieving the sustainable development agenda.

In 2013, the UN launched the "Call to Action on Sanitation" campaign that aimed at alienating open defecation by the year 2025 it underlines the need for universal access to sanitation as a means of achieving an ODF environment (United Nations, 2013). The World Toilet Day launched by the United Nations Secretary General in November 2013 emphasized sanitation for all as a development priority (United Nations, 2013). The objective of the initiative is to create awareness on change of behavior towards sanitation practices, develop and implement policies that increase access to sanitation among the poor and, eliminate open defecation (United Nations, 2013). In May

2014, the United Nations Deputy Secretary General launched the "Global Campaign to Access Toilets" for then, 2.5 billion people without basic sanitation by 2025 (United Nations, 2014).

The Kenya Vision 2030 stipulates strategies the Kenyan government has put in place to ensure access to clean, safe water and sanitation by all by the year 2030 (GoK, 2007). The Kenya Environmental Sanitation and Hygiene Strategic Framework (KESSF) 2016-2020 provides the blue print to achieving access to highest standard of sanitation and clean environment by Kenyan citizens by 2030. It stipulates strategies to achieving 100% ODF and 55% coverage in improved sanitation by the urban and rural populations by 2020 (Mule et. al, 2016; UN Water; WHO, 2019).

The Ministry of Water and Sanitation Strategic Plan 2018-2022 outlines policies that would guide water and sanitation programs implemented during the same period and its main objective was to increase access to improved sanitation by the national population from 68% in 2017 to 80%, the urban population to 85%, the rural population to 76% by 2020 (UN Water; WHO, 2019)..

The National ODF Kenya 2020 Campaign Framework 2016/2017-2019/2020 provided the guideline for attaining an open defecation free state by the year 2020. Its objective was to sensitize and create awareness in the rural and urban populations to invest on or, upgrade from basic sanitation facilities to improved sanitation (Mule et.al, 2016; UN Water; WHO, 2019). The Ministry of Water and Irrigation developed the Pro-Poor Implementation Plan for Water Supply and Sanitation (PPIP-WSS) 2007 to accelerate attainment of Millennium Development Goals tied to sanitation (UN Water; WHO, 2019). The Objective of PPIP-WSS was to half the proportion of people without access to water and sanitation by 2015, thereafter move towards universal coverage of water and sanitation based on basic human rights standards (UN Water; WHO, 2019; MWI, 2007).

Kenya is yet to realize the goals it has set out to achieve as a country in the various sanitation strategies towards an ODF status by year 2030. The country's OD rate currently stands at 14%, with an OD decline rate of 0.75%, making the KESSF 2016-2020 target of 100% ODF status almost unachievable (Njuguna & Muruka, 2019; Mule et.al, 2016). There still exist disparities in access to improved sanitation with 50.8% of the rural households having no access to improved sanitation compared to 13.2% in the urban (Development Initiatives, 2018). In addition to this, coverage of sewerage services by the urban population is below 20% against the MOWs 2018-2022 target of 40% with only 5% of the sewage being treated appropriately (Development

Initiatives, 2018; Mansour, Oyaya, & Owor, 2017). Various development partners fund and implement investments in sanitation for pro poor populations and CLTS initiatives in Kenya who generate different and separate reports on ODF outcomes and achievements, to this effect, data on ODF status is disaggregated and estimation of the current number of ODF villages to be quite complex (Mansour, Oyaya, & Owor, 2017).

1.2 Problem Statement

Kenya has put in place first-rate strategies to eliminate OD and ensure universal access to improved sanitation. Additionally, respective government ministries collaborated with development organization to provide affordable and sustainable sanitation solutions in a bid to realize an ODF country by 2030 (Ombacho et. al, 2013). However, the rate of uptake of improved sanitation facilities is deficient. A study by Development Initiatives indicates access to improved sanitation increased by a dismal 0.2% between 2009 and 2015/2016, while the OD rate stands at 14% with an annual decline rate of 0.75% implying the country will attain ODF status in 133years (Development Initiatives, 2018; Mule et.al, 2016).

Low rates of uptake of improved sanitation facilities in Kenya is attributed to the high rates of poverty with access to improved sanitation, higher in counties with low poverty gap index compared to those with high poverty gap index (Mule et.al, 2016). Additionally, unavailability of sanitation infrastructure, poor maintenance of existing facilities and poor disposal practices of child feces contribute to low uptake rate of improved sanitation facilities in Kenya (Development Initiatives, 2018; Mule et.al, 2016).

It is evident that past global and regional sanitation studies (Agbadi, Darkwah, & Kenney, 2019; Kema, 2012; O' Conell, 2014; Sara & Graham, 2014; Sinha et. al, 2017; The World Bank: IFC, 2017), focused on determining the sociodemographic factors and sanitation product characteristics that influence choice of sanitation product and behavior. Although, The World Bank through its Water and Sanitation Program (WSP) undertook a study on the economic impact of poor sanitation in Kenya (WSP, 2012), there is minimal research on socioeconomic determinants of choice of sanitation facilities and behavior. Jenkin and Scott (2007) downplayed the role of household socioeconomic characteristics as determinants of demand for sanitation products and change in sanitation behavior. However, a study by Minh et.al, (2012) to assess willingness to pay for improved sanitation in Vietnam found, household socioeconomic factors as key determinants of

the willingness to pay rate and amount. There are no past studies conducted to ascertain the socioeconomic determinants of choice of sanitation facility by households in Kenya.

Past studies (Cole, 2018; Geertz & Iyer, 2018; Cavill, 2016; Patkar, 2016; Agbadi, Darkwah, & Kenney, 2019; Osumanu, Kosoe, & Ategeeng , 2019; Wilhelm, 2017; Yimam, Gelaye, & Chercos, 2014; Kema, 2012) focused on age, gender, education and income as psychosocial factors affecting utilization of sanitation facilities and overlooked their socioeconomic effects. Additionally, though these studies have focused on the Sub Saharan Africa; empirical data on the Kenyan situation is limited. This study therefore aimed to assess the effect of income, education, age and gender on choice of sanitation facility by households in Kenya.

1.3 Objectives

General objective

The study aimed to determine the effects of socio-economic factors on household utilization of improved sanitation facility.

Specific Objectives

The specific objectives of this study were:

i. To determine the effect of education level of household head on household utilization of improved sanitation facility
ii. To determine the effect of household income on household utilization of improved sanitation facility.
iii. To determine the effect of age of household head on household utilization of improved sanitation facility.
iv. To determine the effect of gender of the household head on household utilization of improved sanitation facility.

1.4 Study Hypotheses

The null hypotheses of this study were:

i. Education level of household head had no effect on household utilization of improved sanitation facility.
ii. Household income had no effect on household utilization of improved sanitation facility.

iii. Age of household head had no effect on household utilization of improved sanitation facility.

iv. Gender of household head had no effect on household utilization of improved sanitation facility.

1.5 Contribution of Study

Sanitation is a critical driver of the sustainable development agenda. Successful implementation of SDG 6 determines attainment of other key goals such as ending poverty, ensuring health for all, equity and inclusivity in education, environmental sustainability, gender equality and women and girls' empowerment, making human settlement inclusive, safe, resilient and sustainable, and conservation of both blue and green ecosystems (United Nations, 2015). The Kenya constitution guarantees every Kenyan the right to sanitation and clean and healthy environment. Vision 2030 goal on sanitation aims at ensuring availability and access to adequate water and sanitation by all by the year 2030, there is therefore need to accelerate implementation of strategies to eliminate open defecation (GoK, 2007). Though non-governmental agencies are working with the government through, community led total sanitation programs and development of innovative sanitation solutions that address open defecation; the OD decline rate remains wanting (Ombacho et. al, 2013). According to Musyoki Musembi, Kenya presents a setting with limited resources that are not well coordinated at all levels of governance and operations, it is therefore important to identify factors that influence choice of sanitation facility (Musyoki, 2016). This would guide adoption of the most cost effective initiatives that would eliminate open defecation.

WaSH studies in Kenya have majorly focused on access to improved water services with little emphasis on access to improved sanitation (Development Initiatives, 2018). Evidence from this study therefore intended not only to add content to existing literature on the Kenyan sanitation situation, but also to emphasize the need for WaSH policy makers and project implementers to focus on population access to improved sanitation. The findings form an information database that will inform decisions in sanitation policy and planning, and will guide program and project managers in implementation of effective sanitation projects. Past studies have majorly focused on the sociocultural and sociodemographic factors affecting adoption of appropriate sanitation products and behavior. Focus socioeconomic factors as determinants of choice of sanitation facility in this study therefore, provides an alternate approach to sanitation studies in the future. The results

from this study builds evidence on the role of household's socioeconomics in choice and use of sanitation facilities.

1.6 Organization of Study

Chapter 2 of this study focused on the theoretical and empirical literature that explain factors that influence individual's sanitation behavior and adoption of latrine. Chapter 3 focused on the study methodology. It expounded on the study's model, the parameters of interest, and diagnostic tests for the model of choice and the sources of data for the study. Chapter 4 covered the results and findings from data analysis. It discusses the study findings in the context of previous studies and Chapter 5 concludes the study with a summary of the study and recommendations.

CHAPTER TWO

LITERATURE REVIEW

2.0 Introduction

Various sanitation behavioral models, frameworks and studies have explained factors influencing individual's choice for, adoption and use of sanitation facility. While there are multiple Water Sanitation and Hygiene (WaSH) models and frameworks, this study reviewed three behavioral models and one frameworks that were applicable to either sanitation or all WaSH practices. The study further reviewed empirical studies that explained the determinants of adoption and utilization of sanitation facility.

2.1 Theoretical Framework

2.1.1 The Household Sanitation Adoption Decision Making Model

Household's decision to adopt a sanitation solution emanates from social marketing strategies that create awareness and, demand for the sanitation product (Jenkin & Scott, 2007). In this model, motivation, opportunity and ability are the key determinants of decision to adopt a sanitation product (Jenkin & Scott, 2007). Assumes decision to adopt a sanitation product is a three-stage process: preference, intention and choice, these result from evolving attitudes, knowledge and actions (Jenkin & Scott, 2007). Motivation and awareness of the available sanitation options influence preference for a sanitation solution (Jenkin & Scott, 2007). The household plans and budgets for a sanitation improvement at the intention stage. At this stage, the perceived benefits of the sanitation solution determine household opportunity costs and, its prioritization among other competing household spending demands (Jenkin & Scott, 2007).

The assumption is the household at the choice stage, has the ability to control opportunities to carry out intention and, has a high probability to improve its sanitation behavior or product (Jenkin & Scott, 2007). Motivation that is, access and availability of resources; financial, material and, knowledge to adopt a sanitation solution is key at the choice stage (Jenkin & Scott, 2007). Observable sanitation improvement is a result of choice.

The model emphasizes individual attitudinal and structural characteristics as determinants of demand for sanitation and downplays the role of contextual factors specifically, socioeconomic characteristics in acquisition of sanitation solution (Jenkin & Scott, 2007). However, decision to

adopt a sanitation product is a mix of attitudinal, structural and contextual characteristics, the latter dominantly missing in the model (Jenkin & Scott, 2007; Dreibelbis et. al, 2013). While structural and attitudinal characteristics come into play in the first stage of preference, where focus is on reason for acquisition of a sanitation product, contextual factors are key at the intention stage without which households cannot move to the next stage of choice (Jenkin & Scott, 2007). Jenkin and Scott admit marketing strategies cannot solely address the financial inability to adopt a sanitation product and, recommend provision for legislation and policies to increase saving and credit financing toward sanitation improvement (Jenkin & Scott, 2007). The model presents a clear path for monitoring progress in sanitation behavior change within a population from the initial stage of preference, to finally adopting a sanitation product conversely; has no element of sustenance and consistency in use and maintenance of the sanitation product (Dreibelbis et. al, 2013).

2.1.2 RANAS Model

The RANAS model is in the form of a control trial model, comparing the desired behavior to the competing (undesired) behavior. Mosler and Contzen categorize behavioral factors into five: risks, attitudes, norms, ability and self-regulating factors (RANAS). All the five behavioral factors are necessary for effective behavior change therefore; guide the development of behavior change techniques, which are strategies and interventions critical to altering behavior (Mosler & Contzen, 2012).

The model has a unique element of the doer- non-doer analysis conducted at the planning stage of sanitation initiative or program that identifies the most critical behavioral factors addressed by behavioral change techniques (Mosler & Contzen, 2012). The contextual factors form the pre-existing environment that influence behavioral factors by altering them or their influence on behavior (Mosler & Contzen, 2012). The model summarizes behavioral outcomes into behavior or use, intention and habit (Mosler & Contzen, 2012). Behavior is performing the expected action. It can be either desired or opposing for example, using a sanitation facility or practicing open defecation. Intention is will to perform a behavior while habit is a repetitive behavior performed intuitively and is essential for sustainability of a behavior (Mosler & Contzen, 2012).

Similar to the Jenkin and Scott household sanitation decision-making model, the RANAS model creates demand by changing behavior and strengthening availability of supporting products

(Dreibelbis et. al, 2013)**.** RANAS model further relate to Jenkin and Scott model in its assumption that, effective behavior change is by altered perceptions, beliefs, thoughts and attitudes otherwise known as behavioral factors that characterize the mind in regards to behavior (Mosler & Contzen, 2012). Intention in the RANAS model is an outcome behavior unlike the Jenkin and Scott household sanitation decision-making model, where it was a progression stage towards behavior change. Additionally it lacks the element of follow up on population with intention to adopt behavior, to ascertain the proportion that attained behavior change in the long term. However, the RANAS model can be applicable across all WaSH programs. The doer- non-doer analysis results in targeted interventions consequently, increasing effectiveness in behavior change under prevailing local conditions (Dreibelbis et. al, 2013; Mosler & Contzen, 2012).

2.1.3 SaniFOAM Conceptual Framework

The SaniFOAM framework categorizes determinants of sanitation behavior into three. Devine (2009) describes opportunity determinants as influencers of the possibility of an individual to engage in desired behavior. These include access and availability of sanitation product or service by target population; the product attributes in reference to quality and extent to which it addresses the population's sanitation need (Devine, 2009). The social norms are the unwritten societal laws that facilitate or deter sanitation behavior; in the SANIFOAM framework, they include sanctions and enforcements to castigate deviation from expected practice (Devine, 2009)

Ability determinants influence the capacity to engage in an expected sanitation behavior. The level of knowledge on sanitation influences the extent to which individual engage in appropriate sanitation behavior. Skills, self-efficacy, social support and affordability determine the capacity for individuals or household to acquire a sanitation product or technology (Devine, 2009). Motivation determinants are drivers for an individual to engage in specific behavior. They take into account attitudes and beliefs that determine individuals' perception and understanding of a sanitation behavior or product. Values entail beliefs and attitudes of a community and are key in implementation of CLTS while competing household priorities are motivation factors that determine the importance apportioned to sanitation, with households with pressing financial needs ranking it low in the household expenditure ladder (Devine, 2009).

The RANAS and Jenkin & Scott models focused on increasing uptake of sanitation product or behavior by employing social marketing and behavior change strategies (Mosler & Contzen, 2012;

Jenkin & Scott, 2007). In contrast, the SaniFOAM conceptual framework seeks to identify barriers and gaps that hinder individuals who have adopted sanitation products, from moving up the sanitation ladder consequently, revert to open defecation (O' Conell, 2014; Devine, 2009)In this framework, Devine (2009) similar to Jenkin & Scott (2007) assumes demand for sanitation solution is a result of opportunity, ability and motivation. Whereas the Jenkin and Scott model assesses through a generalized lens, the role of opportunity, ability and motivation at each stage of decision-making process to adopt a sanitation product, the SaniFOAM framework assesses specific components that form these three psychological determinants and, analyses the effect of each component on sanitation behavior (Devine, 2009). These components form the barriers or drivers to acquisition of sanitation product or behavior depending on the contextual environment (Devine, 2009).

In contrast to the Jenkin & Scott model and the RANAS model where intention was a stage in the decision making process to adopt a sanitation product and, an outcome behavior respectively, in the SaniFOAM framework it is a component of the motivation factor (Mosler & Contzen, 2012; Devine, 2009; Jenkin & Scott, 2007). The framework does not explicitly identify contextual factors instead, groups selected factors such as affordability and role in decision making under psychosocial factors (Dreibelbis et. al, 2013). Socio-demographic factors are key determinants of individual's movement up the sanitation ladder however, these factors are absent in the SaniFOAM framework (O' Conell, 2014).

2.1.4 Integrated Behavioral Model for WaSH (IBM-WaSH)

Integrated Behavioral Model for WaSH (IBM- WaSH) positions individual behaviors within a multi-causal framework with three dimensions also termed as the causal factors, that influence WaSH behaviors aggregated at five levels of interaction (Dreibelbis et. al, 2013). It assumes factors influencing sanitation behavior as multilevel and multidimensional and hence, develop interventions to alter WaSH practices and behaviors based on a similar approach (Dreibelbis et. al, 2013). Contextual dimension in the IBM-WaSH model are the conditions of an individual or environment that influence the adoption of a behavior. They include access to markets, products and enabling resources, socioeconomic characteristics, socio-demographic characteristics, household characteristics and environmental characteristics both built and natural (Dreibelbis et. al, 2013).

The psychological dimension consists of behavioral, social and psychological determinants that are responsive to WaSH Interventions. These directly influence WaSH behavior outcomes and adoption of sanitation technology and, are the components of CLTS initiatives and behavior change strategies at community and household levels. The model categorizes attributes of technology or product that influence its adoption and sustained use, under the technological dimension

The five levels of IBM-WaSH model cut across all the three dimensions. The societal or structural level denotes organizational factors, institutional factors, cultural factors, and laws and legislations that influence behavior in each of the dimensions. The community level encompasses the individual's physical and social environment, inclusive of informal and formal institutions that form their experience. The interpersonal level entails close interaction between individuals at basic social unit level, most commonly household. The individual level includes socio-demographic factors and personal attitudes towards a product or behavior. Habitual level consists of individual factors that contribute to their repeated use of sanitation product or practice of a WaSH related behavior that finally results to a behavior outcome (Dreibelbis et. al, 2013).

The contextual factors in the IBM-WaSH model form the environment for effective behavior to occur, but are dominantly missing in the household sanitation decision-making model and, the SaniFOAM framework (Dreibelbis et. al, 2013). The RANAS model does not explicitly illustrate the interaction between contextual factors and individual factors (Dreibelbis et. al, 2013). The SaniFOAM framework, the RANAS and, the Jenkin and Scott model lack the element of sustainability and consistency in adopted behavior or use of sanitation technology presented by the habitual level in the IBM- WaSH model (Dreibelbis et. al, 2013).

The contextual dimension of the IBM-WaSH model encompasses socioeconomic and socio-demographic characteristics; a focus in this study consequently, made it the model of choice. Additionally, the model follows the ecological or causal framework that is consistent with public health research (Dreibelbis et. al, 2013). The model is a usable guide for identifying how interaction of the behavioral factors at various levels influence behavioral outcomes (Dreibelbis et. al, 2013). The model exceeds the individual, household and structural levels therefore; interventions can cover a wider scope of population (Dreibelbis et. al, 2013). Measurement of psychosocial factors in the Jenkin and Scott model, SaniFOAM framework and, RANAS model

require more qualitative data to increase their validity and reliability (Dreibelbis et. al, 2013). Secondly, measurements of determinants in the RANAS model do not address inter –relationships with contextual factors whereas, determinants in the IBM-WaSH model are dynamic and inter-related therefore differ across setting and time (Dreibelbis et. al, 2013).

2.2 Empirical Literature Review

The Joint Monitoring Program considers an improved sanitation facility as one that hygienically separates human excreta from human contact, while unimproved sanitation facility does not separate human excreta from human contact and, are public or shared by two or more households (WHO|UNICEF-JMP, 2015). The Program further classifies flush or pour flush to either sewer systems, or septic tank or pit latrines as improved sanitation. The Ventilated Improved Pit latrine that includes pit latrine with a slab and compositing toilet fall in the improved sanitation category while shared sanitation facilities, flush or pour flush that deposit the contents to the environment, latrines without slabs, bucket latrines, hanging latrines and open defecation are considered unimproved forms of sanitation (WHO|UNICEF-JMP, 2015).

There have been studies done at global and regional levels to identify drivers and barriers of adoption and utilization of improved sanitation products. The Development Initiative in 2018 reported 49.2 % proportion of rural households in Kenya using improved sanitation facilities compared with 86.8% proportion of urban population using improved sanitation facilities (Development Initiatives, 2018).The variation in use of improved sanitation facility is attributable to differences in socioeconomic, socio-demographic, sociocultural and environmental factors.

Availability of financial resources, household disposable income, affordability of the product, competing household demands for spending and, willingness to pay for the sanitation improvement contribute to the variation in choice of sanitation product between the poor and the rich households (The World Bank: IFC, 2017; Sara & Graham, 2014; O' Conell, 2014; Corburn & Hildebrandt, 2015).

In an evidence review of CLTS sanitation programs in SSA, (Munkhondia, Simangolwa, & Maseda, 2016), noted digging a pit in Kenya costed approximately USD 360, this accounted for 70% of the average annual income of household in the lower wealth quintile consequently, poor households were constantly prone to own unimproved sanitation facilities and, highly likely to revert to OD. Conversely, households with larger disposable incomes opted to upgrade to more

expensive sanitation options compared to those with low disposable income (Munkhondia, Simangolwa, & Maseda, 2016). A mixed method study on effects of socioeconomic and sociodemographic factors on willingness to pay for improved sanitation in Vietnam found non–poor households with double vault toilets more willing to pay for sanitation improvements compared to poor households with single vaults toilets (Minh.V.H, Nguyen-Viet. H, Nguyen H.T, Yang J, 2012). Low willingness to pay rates further escalated the cost of improved sanitation solutions, subsequently decreasing their demand in poor households (Minh, Nguyen-Viet, & Yang, 2012; The World Bank: IFC, 2017). Results from a similar study in Philippines by IFC (2017), further confirmed, low-income households opted for pay- per-use communal latrines attributable to perceived high cost of improved latrines and, limited and inconsistent cash flow that impeded them from making one off investments on improved sanitation (The World Bank: IFC, 2017).

On the contrary, communal latrines provided inadequate sanitation and were more costly than improved latrines in the long term; households utilizing these facilities had a low rate of progression up the sanitation ladder (The World Bank: IFC, 2017; Geertz & Iyer, 2018). Corburn and Hildebrandt (2015) reviewed household survey data of low-income settlements in Nairobi to determine effects of poor sanitation on women's health, noted, increased medical costs, productivity time lost in seeking treatment for illness associated with use of shared latrines escalated sanitation cost from 3 % to 10% of the total household expenditure of the low income household (Corburn & Hildebrandt, 2015). The cost of utilization of pay-per-use community latrines increased proportionately with household size subsequently, affected households had a high probability of reverting to open defecation (The World Bank: IFC, 2017; Corburn & Hildebrandt, 2015). Jenkin & Scott (2007) survey study in Ghana on household sanitation decision-making, disregarded effects of socioeconomic factors on household sanitation however, noted financial constraints inhibited 25% of households with intention from adopting a sanitation facility.

Willingness to pay for and, affordability of improved sanitation solution are key in progression on the sanitation ladder however; these two key factors are realizable with availability of financial resources (Munkhondia, Simangolwa, & Maseda, 2016). It was evident from the studies in South East Asia and Sub- Saharan Africa; that without external financial assistance to invest on improved sanitation solution, the poor were most likely to revert to OD or remain in the lowest rank of the

sanitation ladder (The World Bank: IFC, 2017; Munkhondia, Simangolwa, & Maseda, 2016). The UNICEF led phased approach to rural sanitation in the Philippines affirmed credit financing strategies targeted at the poor and, development of sanitation products that were affordable across all wealth quintiles was necessary to effectively eliminate open defecation and sustain an ODF community (Robinson & Gnilo, 2016).

Alternatively, provision of sanitation solutions at subsidized costs would bridge the gap between the amounts poor households are willing to pay and the actual cost of sanitation facilities (The World Bank: IFC, 2017). Provision of instalment payment system rather than one off payment for a sanitation product would address the limited and intermittent cash flow that hindered poor households from adopting sanitation solutions (The World Bank: IFC, 2017).

Education is not only an input factor of health outcomes especially in Sub Saharan Africa, but study evidences by Osumanu et.al, (2019), Agbadi et.al, (2019) and Wilhelm (2017), linked it to sanitation behavior change. Agbadi et.al, (2019) in a multi variate analysis of Ghanaian demographic survey data to determine regressors of access to improved sanitation found education significantly affected access. These findings corresponded with Osumanu et.al, (2019) study results derived from analysis of data collected through a mixed approach method to assess determinants of open defecation. Osumanu et.al (2019) and Agbadi et.al (2019) agreed educated individuals were aware of the effects of open defecation and the health benefits of good sanitation therefore, were highly likely to invest in improved sanitation. Findings from a cross sectional study to determine factors associated with latrine utilization in rural Ethiopia, showed households whose members were educated to secondary school level, were more likely to use latrine compared to those less educated (Yimam, Gelaye, & Chercos, 2014). Individual literacy level related closely with income earning capacity subsequently, households with educated heads and members, had high income earning capacity therefore, had access to financial resources for construction or adoption of an improved sanitation technology (Osumanu, Kosoe, & Ategeeng , 2019; Agbadi, Darkwah, & Kenney, 2019; O' Conell, 2014). Agbadi et.al (2019) and Osumanu et.al (2019) observed households with educated heads had 18.5% higher likelihood not to open defecate than their counterparts while 65% households of uneducated heads did not own a sanitation facility and were highly likely to open defecate.

Wilhelm (2017) associated effective elimination of open defecation with increased levels of female literacy, contrary to studies by Agbadi et.al (2019), Osumanu et.al (2019) and Yimam et.al (2014) who did not view the effect of education on access and use of improved sanitation through a gender lens. The Water Policy Program analyzed sanitation data derived from the India census and concluded that success of the Swachh Bharat Mission in Kerala was due to involvement of educated women who also, led the implementation process (Wilhelm, 2017). The study further noted quality of sanitation facility improved with increase in female literacy, which also, accounted for 24.3% of variation in distribution of improved sanitation facilities (Wilhelm, 2017).

Demographic survey data indicate percentage availability of latrines in households headed by both gender and, not the difference in utilization between male and female (Geertz & Iyer, 2018). Variation in access and use of sanitation facilities between men and women is a factor of gendered roles and norms that influence household's decision-making on sanitation improvement (Geertz & Iyer, 2018; Cavill, 2016; Patkar, 2016). Women's demand for sanitation is high due to the physiological characteristics however, cultural and gender norms inhibit them from utilizing sanitation facilities and, they are forced to open defecate (Geertz & Iyer, 2018; Patkar, 2016; Cavill, 2016). Inadequate sanitation affects both gender conversely, women bear a greater sanitation burden and, experience more sanitation related time poverty than men when addressing their own sanitation hygiene, that of their children, the elderly and sick also, in maintenance and cleanliness of the sanitation facilities (Corburn & Hildebrandt, 2015). Despite bearing the greatest need for quality sanitation, gender related dynamics at the households excludes women from decision making on sanitation improvements thereby, their unique sanitation needs are overlooked leading to persistent disparity in their access and use of sanitation facilities (Corburn & Hildebrandt, 2015).

The social responsibilities and unique sanitation needs positions women as the best influencers of household sanitation improvement however, men have greater control over the household financial resources therefore, have greater decision-making power to invest on sanitation, and the type of sanitation improvement to adopt (Geertz & Iyer, 2018). Minh et.al (2012) found men 6 times more willing to pay and, less concerned about financial constraints when making decision for a sanitation improvement than women, in contrast, women present with greater need for sanitation, therefore were best placed to inform and influence men' decision on sanitation at the household

level (Geertz & Iyer, 2018). Households where women are less financially empowered have high probability to revert to open defecation; as evidenced in reviews of studies and reports on women sanitation in Nepal, where 10% of households majorly headed by women reverted to open defection due to financial constraints (Cavill, 2016; Patkar, 2016).

In settings where gendered norms are non-existent, 100% utilization of sanitation facilities by women is a factor of location, privacy and, safety of the facility without which they revert to open defecation (Cavill, 2016; Geertz & Iyer, 2018; Corburn & Hildebrandt, 2015). Additionally, the frequency of use of sanitation facilities is higher in women than in men, consequently, pay- per-use latrine are inequitable and, costly especially for women with no income or with limited control of household financial resources, subsequently predisposing them to open defecation (Geertz & Iyer, 2018). Women owing to their unique sanitation demand and role in household play a center role in household sanitation subsequently, ODF status is more likely to be sustained and embedded if women lead the decision making process on household sanitation (Geertz & Iyer, 2018; Cavill, 2016; Patkar, 2016).

Findings from evidence reviews and survey studies in Vietnam, Ghana, Tanzania, Kenya and countries in Southeast Asia and Sub – Saharan Africa indicated age as one of the factors that determined willingness to pay, ownership and, utilization of sanitation facilities (Minh, Nguyen-Viet, & Yang, 2012; Cavill, 2016; WSP; UNICEF, 2015; Agbadi, Darkwah, & Kenney, 2019; Kema, 2012). Furthermore, similar studies in these regions linked child health outcomes; stunting and wasting, morbidity, infant mortality to poor sanitation (Wiyono, 2018; Dearden, 2017; Alemu, 2017; Mahmud & Mbuya, 2016). In Vietnam, Minh et.al, (2012), noted household heads between 25 and 54 years of age were more willing to pay for a sanitation improvement than those of ages 24 years and below. Individuals between 25 and 54 years represented the economic productive age bracket, and had disposable income and financial ability to invest in a sanitation improvement (Minh et.al, 2012). The elderly's need for improved sanitation was high owing to their age and, deteriorating health (Cavill, 2016; Patkar, 2016). However, Minh et.al (2012) found household heads 60 years of age or more, less willing to pay for a sanitation improvement attributable to being in the less economically productive age and, unemployed therefore had limited financial ability to invest in a sanitation improvement.

An almost similar study by Tuan & Chi (2017) contrasted to Minh et.al, (2012), with household heads 60 years of age or more, willing to pay a higher amount towards solid waste management than those between 31 and 45 years of age. Decline in financial responsibilities coupled with financial support received from children in the economically productive years, enabled individuals at 60 years and above to be willing to pay more for waste management services (Tuan & Chi, 2017). On the other, household heads in the economically productive years were willing to pay less for solid waste management attributable to pressure exerted by other competing household demands on the limited household financial resource (Tuan & Chi, 2017). There is need for a further in-depth study to ascertain the effect of association between WTP amount and age in investing on a sanitation improvement.

In SSA, Agbadi et.al, (2019) noted ownership of improved sanitation facility was high in households whose heads were 35 years or older. Cross sectional study on factors affecting utilization of VIP latrines in Tanzania, confirmed individuals 35 years or older were conscious of the health benefits of good sanitation, the improved social status and pride associated with ownership of improved latrine and, had financial ability to invest in an improved sanitation facility (Agbadi, Darkwah, & Kenney, 2019; Kema, 2012). On the contrary, a similar cross sectional study by Sara & Graham (2014) found no association between latrine ownership and age. They credited the findings to the study sample drawn from rural Tanzania that, were majorly nomadic pastoralists who owing to their occupation had a low rate of ownership of improved latrine (Sara & Graham, 2014).

The Water and Sanitation Program conducted an evidence review of multiple indicator clusters and demographic health surveys to profile disposal practices of child feces in Kenya (2015) and found utilization of sanitation facilities varied with age. Households with children under 3 years of age reported unsafe child feces disposal, irrespective of the household's sanitation facility type. Though households practicing OD reported highest rate of unsafe child feces disposal, the practice was observed also in household with improved sanitation facilities this was attributed to the inability of children 3 years and below to use sanitation facilities and the poor fecal disposal behavior of child attendants (WSP; UNICEF, 2015). The WSP (2015) study found 64% of households with improved sanitation did not dispose child feces into an improved latrine while 23% had their children open defecate. Safe fecal disposal increased proportionately with age, with

highest rate of safe disposal observed in older children (WSP; UNICEF, 2015). On the other hand, there was decline in use of sanitation facility among the elderly especially in cases where convenience of use and, proximity to the facility were overlooked in the adoption stage of the sanitation decision-making process (Cavill, 2016; Munkhondia, Simangolwa, & Maseda, 2016; Patkar, 2016).

2.3 Overview of Literature Review

Mosler and Contzen (2012), Jenkins and Scotts (2007) and Devine (2009) in their models focused on psychological factors that influenced sanitation behavior however, the IBM-WaSH model Dreibelbis et.al, (2013) recognized sanitation behavior was a product of interactions between psychological and contextual factors (Dreibelbis et.al, 2013). Diversely from sanitation models and frameworks that create demand for sanitation product and, or behavior through social marketing and, strengthen availability of the supporting products and services, the IBM-WaSH ecological framework is a useful tool that factors in full scope of determinants of sanitation behavior before implementation of behavior intervention (Dreibelbis et.al, 2013).

Willingness to pay and affordability were barriers to the poor households' progression on the sanitation ladder owing to their financial incapability (Robinson & Gnilo, 2016; Munkhondia, Simangolwa, & Maseda, 2016). The literature review noted including women in the sanitation decision making process and, focusing on their education and literacy as an effective approach in fast-tracking progression of households on the sanitation ladder and attainment of an ODF community (Geertz & Iyer, Wilhelm, 2017). Cost effective sanitation interventions therefore, should take an intentional approach to gender with focus on women and girls to realize both household and community's progression up the sanitation ladder (Corburn & Hildebrandt, 2015). The needs of the elderly and children under three are often not factored in the decision making process for household sanitation consequently, these age groups have high rates of underutilization of sanitation facilities (Cavill, 2016; Patkar, 2016; WHO|UNICEF-JMP, 2015). Effective utilization of sanitation products is realized when the products address the needs of economic and non-economic productive age groups (Cavill, 2016; Patkar, 2016).

CHAPTER THREE

METHODOLOGY

3.0 Introduction

The study was a cross sectional study that followed the IBM-WaSH model (Dreibelbis et. al, 2013) and, entailed multivariate analysis of data on sociodemographic and socioeconomic characteristics of households collected with use of household questionnaires in the 2015/2016 Kenya Integrated Household Budget Survey (Mwangi, 2018).

3.1 Theoretical Framework

The Integrated Behavioral Model for Water, Sanitation and Hygiene combines the elements from different behavioral models and frameworks to form a conceptual and practical tool for designing and, evaluating multilevel and multidimensional factors that influence sanitation behavior and practices in resource-limited settings (Dreibelbis et. al, 2013). The model follows an ecological framework that is common to public health research studies and applicable to this study (Dreibelbis et. al, 2013). The individual and, household levels of the IBM-WaSH model encompass the demographic and socioeconomic factors that affect adoption of sanitation product and behavior a key focus in this study (Dreibelbis et. al, 2013). The IBM-WaSH model is a derivative of the socioecological model that explains individual's behavior as a product of their interaction and the environment within a multilevel system consisting of individual, interpersonal, community, organizational, and policy or enabling environment (Aronica, Crawford, Licherdell, & Onoh, 2019).

It took the form:

$$\frac{dx}{dt} = \alpha x(1-x)[-\beta F + \gamma + x]$$

$$\frac{dF}{dt} = \beta(1-F) - DF + xF \qquad (3.1)$$

Where:

x – Proportion of cooperators that is, individuals that utilize resource appropriately, in this study, use of improved sanitation facility.

1- x – Proportion of defectors, in this study, individuals not using improved sanitation facility.

F- Resource carrying capacity, number of households sustained by the available improved sanitation facilities.

D- Resource depletion rate, in this study underutilization of improved sanitation facility.

ϒ- Resource harvesting cost, in this study the cost of utilizing improved sanitation facility.

β – Resource productivity rate, in this study benefit per unit value in monetary term derived from utilizing improved sanitation facility

α – Proportionality constant.

3.2 Empirical Framework

This study utilized secondary data that followed a normal distribution, to determine the effect of multiple independent variables on the response variable: 'household sanitation facility'. Household sanitation facility was measured as a dummy variable where one (1) denoted predictor variable was significant in influencing household's use of improved sanitation facility and zero (0) otherwise thereby, effected Probit regression as the model of choice for the study (O' Halloran, 2016; Carpena, 2016). The link function in probit regression model is the normal distribution therefore facilitated simultaneous estimation of several variables and, controls for different marginal effects at different levels of each variable (O' Halloran, 2016). The cumulative distribution function Φ restricts predicted probability to between 0 and 1 (Carpena, 2016).

The Probit model with k regressors took the form:

$$(Y = 1|X) = \Phi(\beta_0 + \beta_1 X_1 + \beta_2 X_2 \ldots . + \beta_k X_{k)} \quad (02)$$

Where:

Y- The predicted probability of an event occurring, in this study it was use of improved sanitation facility.

β_0- The reference level of each of the predictor variables $X_1 \ldots X_k$.

β_k - The regression coefficients associated with the reference level and X_k predictor variables.

X_k - The sum of predictor variables. In this study, they included household income, household head education, occupation, age, gender, and, marital status, household size, type of housing unit, house tenure and, household place of residence.

The model fit was a 10-predictor model:

$$\begin{aligned} &P(\text{Improved sanitation facility}|X) \quad (03)\\ &= \Phi(\beta_0 + \beta_1\,\text{householdincome} + \beta_2\text{education}\\ &+ \beta_3\text{employment status} + \beta_4\text{age} + \beta_5\text{sex} + \beta_6\text{marital status}\\ &+ \beta_7\,\text{household size} + \beta_8\text{house type} + \beta_9\text{tenure} + \beta_{10}\,\text{residence}) \end{aligned}$$

3.3 Measurement and Definition of Variables

Table 3:0 Measurements and definition of variables

Variable	Measurement	Definition	Expected Sign	Literature Source
Outcome				
Household sanitation facility	Type of household sanitation facility.	Unimproved if bucket latrine or hanging latrine or pit without slab or flush to unknown or bush = 0, Improved if VIP or slab, or compositing pit or flush to septic, sewer or pit = 1		(Agbadi, Darkwah, & Kenney, 2019)
Predictors				
Household Income	Total monthly gross income generated by individual household members	If Very Low ≤20,000, = 0, Low 20,000>income≤40 ,000=1,	Negative (-ve)	(Osumanu, Kosoe, & Ategeeng , 2019; Mwangi, 2018)

		Middle 40,000>income≤60,000=2, High 60,000>income≤80,000=3, Very high ≥80,000=4		
Employment status	Income earning activity of household head	If unemployed in formal or informal activity = 0, If employed in formal or informal activity =1		(Kema, 2012)
Education	Highest level of education of household head.	If Preschool or no formal education=0 Primary=1, Secondary=2, Tertiary=3	Negative (-ve)	(Osumanu, Kosoe, & Ategeeng , 2019)
Age	Total number of years from birth of household head.	Individual's years	Positive(+ve)	(Osumanu, Kosoe, & Ategeeng , 2019)
Sex	Sex of household head.	If female =1, and 0 if otherwise.	Positive(+ve)	(Osumanu, Kosoe, & Ategeeng , 2019)

Marital status	Marital status of household head.	If Never married(Single) = 0 Married =1, Separated/Divorced =2, Widowed =3	Positive (+ve)	(Osumanu, Kosoe, & Ategeeng , 2019)
Household Size	Number of members in a household.	Individuals in units	Negative/positive (-ve/ +ve)	(Osumanu, Kosoe, & Ategeeng , 2019; Abbam, A, 2018);
House type	Type of household main dwelling unit.	If Bungalow or maisonnette or flats = 1, Traditional mudhouse or manyatta or shanti or landhi =0,	Negative/positive (-ve/ +ve)	(Mwangi, 2018)
Tenure	Household ownership status of main dwelling unit.	If Owner = 1, Not owner (rents or squats) = 0,	Negative/positive (-ve/ +ve)	(Mwangi, 2018)
Residence	Region of residence of household	If Rural = 0, Urban =1	Negative (-ve)	(Abbam, A, 2018; Agbadi, Darkwah, & Kenney, 2019)

3.3 Diagnostic Tests

3.3.1 Model Specification

The analysis utilized linktest to assess adequacy of the fitted model. The analysis added the transformed terms of the independent variables to the fitted model and tested for its significance verses the non-transformed model; with the level of significance, greater than 0.05 after linktest as evidence of correct model specification and mis-specified if otherwise. In case of misspecification, the study varied the predictor variables in the model to obtain the correct model specification.

3.3.2 Multicollinearity test

The study applied the Variance Inflation Factor test to the model to assess presence of correlation between predictor variables and the strength of the correlation (Frost, 2020; Pardoe, Simon, & Young, 2020). VIF tested to what extent variances of estimated coefficients were inflated and, it aimed at increasing precision of the estimate coefficients consequently statistical reliability of the model to identify predictor variables that were statistically significant (Frost, 2020; Pardoe, Simon, & Young, 2020). The study applied a VIF threshold of 10 consequently variables whose VIF exceeded 10 were excluded from the model. Analysis applied correlation matrix on the final model to assess correlation of predictor coefficients with coefficient p-values 0.7 and higher indicating strong correlation, between 0.4 and 0.6 as moderate and, values 0.3 and lower as weak ((Akoglu, 2018). The study intended to exclude predictors with strong correlation from the analysis.

3.3.3 Goodness of fit test

The study applied the Hosmer Lemeshow goodness of fit test to determine the statistical significance of the null models at a significance level of $\alpha = 0.05$ (Sullivan, 2016). The test statistic followed a chi square probability distribution with significance level greater than 0.05 implying; reject the null models and otherwise if less than 0.05. (Sullivan, 2016).

3.3.4 Sensitivity and Specificity test

The study applied the sensitivity and specificity test to assess the predictive accuracy of the fitted model (Bigelow, 2018). The classification table showed a comparison of the successes predicted

by the model against the actual observed values similarly, number of failures against actual observed values (O' Halloran, 2016).

3.3.5 Heteroscedasticity test

The analysis considered presence of heteroscedasticity in the model when the significance values for the predictor coefficients were less than 0.05 and, they jointly explained the dependant variable; test statistic value less than 0.05. The study applied the heteroscedastic probit model to check for heteroscedasticity with test statistic values greater than 0.05 after heteroscedastic probit model implying absence of heteroscedasticity.

3.4 Data Sources

This study utilized the 2015/2016 Kenya Integrated Household Budget Survey data collected between October 2015 and September 2016. The KIHBS applied multistage sampling of the fifth National Sample Survey and Evaluation Program (NASSEP V) sampling frame to obtain 2,400 clusters that were then, randomly assigned to quarter years, resulting in 600 independent clusters per quarter (Mwangi, 2018). The second sampling stage, 16 households were selected from each of the 2,400 clusters and, further sampling yielded sub samples of 10 households out of each of the 16 households. The sub samples were included in the survey; there was random selection of 5 households out of the sub samples of 10 households for administration of diaries (Mwangi, 2018)

The study used demographics and education data collected by the household members' information questionnaire, household sanitation and income data collected by the household level information questionnaire and, household expenditure data collected by the household consumption expenditure questionnaire (Mwangi, 2018)

CHAPTER FOUR

RESULTS AND FINDING

4.1 Introduction

The study included 21,733 households in the final data analysis. The analysis subjected the final data to diagnostic tests for robustness of model and data prior to regression to draw inference.

4.2 Descriptive Statistics

The majority of households (60%) owned improved sanitation facilities and were predominantly (67%) male-headed. The mean age for household heads was 44 years and a majority were educated to secondary school. The mean household income was Kenya shillings 14,500.

Table 4.0 summary statistics for sanitation facility, sex, age, marital status, education, employment status, house income, house size, house type, tenure, residence

Variable	Obs	Mean	Std. Dev.	Min	Max
facility	21,700	.6024885	.4893947	0	1
sex	21,773	.3396868	.4736137	0	1
age	21,773	44.72764	16.1874	12	95
age_cat	21,773	49.8571	16.48529	22.375	95
marital_st~s	21,773	1.2617	.8011117	0	3
education	17,281	1.586887	.7505318	0	3
employment	21,189	.9148143	.2791644	0	1
houseincome	19,538	14504	37769.81	0	1760000
hincome_cat	19,538	.2687583	.6944434	0	3
housesize	21,773	4.264272	2.527212	1	28
housetype	21,665	.6568198	.474782	0	1
tenure	21,735	.6865885	.4638908	0	1
residence	21,773	.3987048	.489643	0	1

4.3 Diagnostic tests

4.3.1 Linktest for model specification

The prediction squared (hatsq) had no explanatory power (0.429) after regressing sanitation facility on prediction and prediction squared, implying correct model specification.

Figure 4-0 regression for sanitation facility on prediction and prediction squared

```
Iteration 0:   log likelihood = -10160.368
Iteration 1:   log likelihood = -8497.9584
Iteration 2:   log likelihood = -8455.912
Iteration 3:   log likelihood = -8455.2812
Iteration 4:   log likelihood = -8455.2807

Probit regression                                 Number of obs     =     16,142
                                                  LR chi2(2)        =    3410.17
                                                  Prob > chi2       =     0.0000
Log likelihood = -8455.2807                       Pseudo R2         =     0.1678
```

facility	Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
_hat	1.027477	.0398043	25.81	0.000	.9494623	1.105492
_hatsq	-.0229608	.0290033	-0.79	0.429	-.0798062	.0338845
_cons	.0006935	.013235	0.05	0.958	-.0252466	.0266336

4.3.2 VIF for Multicollinearity

The final model excluded the employment status to achieve predictor VIF values lower than 10 and, a mean VIF value of 3.28 implying predictors were a linear combination of each other.

Table 4.1 variance inflation factor means and tolerance values

Variable	VIF	1/VIF
tenure	4.72	0.211700
education	4.51	0.221595
housetype	4.51	0.221644
marital_st~s	4.30	0.232454

agesq	4.29	0.233087
residence	2.07	0.483757
hsizesq	2.04	0.490479
sex	1.61	0.622592
hincome_cat	1.45	0.689651
Mean VIF	3.28	

4.4.3 Correlation Matrix

There existed no strong correlation between predictors included in the final analysis. The correlation coefficients ranged from 0.004 for correlation between house income (category) and age (squared) to, 0.4971 for correlation between residence and tenure.

Table 4.2 correlate sanitation facility, sex, age (squared), marital status, education, house income (category), house size, house type, tenure, residence

	facility	sex	agesq	marita~s	educat~n	hincom~t	hsizesq	houset~e
facility	1.0000							
sex	0.0054	1.0000						
agesq	-0.0496	0.0062	1.0000					
marital_st~s	-0.0930	0.3346	0.3067	1.0000				
education	0.2577	-0.0619	-0.1208	-0.1754	1.0000			
hincome_cat	0.1898	-0.1171	0.0040	-0.0887	0.4396	1.0000		
hsizesq	-0.1591	-0.0993	0.1574	0.0121	-0.1078	0.0041	1.0000	
housetype	-0.1023	0.0357	0.2413	0.1337	-0.0105	0.0420	0.1583	1.0000
tenure	-0.3431	0.0134	0.3326	0.2134	-0.2359	-0.1282	0.3428	0.4789
residence	0.2962	-0.0210	-0.1726	-0.1192	0.2234	0.1862	-0.1914	-0.2737

	tenure	residence
tenure	1.0000	
residence	-0.4971	1.0000

4.4.4 Goodness of fit test

Table 4.3 goodness of fit output for probit regression model on socioeconomic factors affecting utilization of improved sanitation facility

Group	Prob	Obs_1	Exp_1	Obs_0	Exp_0	Total
1	0.4121	598	639.5	1118	1076.5	1716
2	0.4606	688	657.9	826	856.1	1514
3	0.5252	854	810.9	791	834.1	1645
4	0.5842	911	887.5	690	713.5	1601
5	0.6690	950	993.3	647	603.7	1597
6	0.7678	1136	1161.0	482	457.0	1618
7	0.8427	1319	1308.2	292	302.8	1611
8	0.8970	1419	1415.7	201	204.3	1620
9	0.9458	1487	1479.4	120	127.6	1607
10	0.9979	1559	1565.9	54	47.1	1613

number of observations = 16142

number of groups = 10

Hosmer-Lemeshow chi2(8) = 21.59

Prob > chi2 = 0.0057

4.4.5 Sensitivity- Specificity Classification test

The study model had a sensitivity threshold of 83.83% and a positive predictive value cut-off of 76.56%.

Figure 4-1 sensitivity-specificity output for probit regression model on socioeconomic factors affecting utilization of improved sanitation facility

	True		
Classified	D	~D	Total
+	9167	2807	11974
-	1768	2414	4182
Total	10935	5221	16156

Classified + if predicted Pr(D) >= .5

True D defined as facility != 0

Sensitivity	Pr(+| D)	83.83%
Specificity	Pr(-|~D)	46.24%
Positive predictive value	Pr(D| +)	76.56%
Negative predictive value	Pr(~D| -)	57.72%
False + rate for true ~D	Pr(+|~D)	53.76%
False - rate for true D	Pr(-| D)	16.17%
False + rate for classified +	Pr(~D| +)	23.44%
False - rate for classified -	Pr(D| -)	42.28%
Correctly classified		71.68%

4.4.6 Test for heteroskedacity

The heteroskedastic probit model obtained a chi- square value of 0.4545 implying the presence of homoskedacity in the final model.

Figure 4-2 heteroprobit model for socioeconomic factors affecting utilization of improved sanitation facilities; dependent variable: sanitation facility

```
Fitting probit model:

Iteration 0:   log likelihood = -10160.368
Iteration 1:   log likelihood = -8496.5343
Iteration 2:   log likelihood = -8455.6875
Iteration 3:   log likelihood =  -8455.591
Iteration 4:   log likelihood =  -8455.591

Fitting full model:

Iteration 0:   log likelihood =  -8455.591
Iteration 1:   log likelihood = -8455.3118
Iteration 2:   log likelihood = -8455.3114

Heteroskedastic probit model                    Number of obs     =     16,142
                                                Zero outcomes     =      5,221
                                                Nonzero outcomes  =     10,921

                                                Wald chi2(9)      =    2240.48
Log likelihood = -8455.311                      Prob > chi2       =     0.0000
```

facility	Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
facility						
sex	.1295504	.0269186	4.81	0.000	.0767909	.18231
agesq	.0000749	8.87e-06	8.44	0.000	.0000575	.0000922
marital_status	-.0748094	.0175704	-4.26	0.000	-.1092468	-.040372
education	.2947478	.0239087	12.33	0.000	.2478877	.341608
hincome_cat	.2404504	.0248463	9.68	0.000	.1917526	.2891483
hsizesq	-.002361	.0004518	-5.23	0.000	-.0032466	-.0014754

housetype	.1876814	.0293641	6.39	0.000	.1301288	.245234
tenure	-.9105803	.038255	-23.80	0.000	-.9855587	-.8356018
residence	.3972727	.0350826	11.32	0.000	.328512	.4660334
_cons	.235232	.0665664	3.53	0.000	.1047642	.3656997
lnsigma2						
tenure	-.0541104	.0732302	-0.74	0.460	-.197639	.0894181

LR test of lnsigma2=0: chi2(1) = 0.56 Prob > chi2 = 0.4545

4. 5 Discussion

The output from the probit regression on the predictors of choice of sanitation facility, showed sex, education, and household income as determinants of household choice of sanitation facility. The findings imply female headed households had a high likelihood to utilize improved sanitation facilities compared to the households whose heads were male. These findings were contrary to the study findings by (Cavill, 2016; Geertz & Iyer, 2018; Minh, Nguyen-Viet, & Yang, 2012; Patkar, 2016) that revealed male and female individuals influenced choice of sanitation products equally; the difference in utilization of improved sanitation facility by households headed by either gender was a factor of household head's financial ability and unique demand for sanitation.

Households with more educated heads were more likely to utilize improved sanitation facilities compared to those with head with less or no education. The findings were similar to those of studies by Agbadi et al (2019), Osumanu et al (2019) and Yimam et al (2014) that indicated educated individuals were more aware of health benefits of good sanitation and were highly likely to invest in improved sanitation facility compared to their less educated or uneducated counterparts.

The results further indicated household income to influence household's choice of sanitation facility where the higher the household's income the more its likelihood to utilize improved sanitation facility. These findings were in concurrence with those of the review study on implementation of CLTS programs in SSA by Munkhondia et al (2016), where household heads with higher disposable income opted for better sanitation solutions compared to those with low disposable income. This is probably due to the differences in the availability of financial resources that is a derivative of disposable income.

CHAPTER FIVE

SUMMARY CONCLUSION AND RECOMMENDATIONS

5.5 Summary

Access to improved sanitation remains a major public health challenge in Kenya evident by the JMP 2019 data on disparity in uptake of improved sanitation facilities and the OD decline rates between the poorest and the richest. There still exists a knowledge gap on socioeconomic determinants of utilization of improved sanitation facilities. This research study endeavored to give insight on the socioeconomic factors affecting household utilization of improved sanitation facilities in Kenya with the view to inform policy and, add content to existing literature on the Kenyan sanitation situation. Probit regression analysis of KIHBS 2016 household data revealed the sex of the household head, their level of education and, the household income as significant determinants of household utilization of improved sanitation facility. Age was not statistically significant therefore did not affect household utilization of improved sanitation facility.

5.6 Conclusion

This research study concludes; the sex of the household head and their level of education and, the household's income effect household utilization of improved sanitation facility. There is need for formulation and implementation of sanitation policies that target the available resources towards knowledge empowerment and diversification of income generating streams with proceeds from such ventures prioritized for investment in improved sanitation facility.

5.7 Recommendations

Previous research findings indicated age of household head as a determinant for choice of household sanitation facility, however this study results indicate it is not statistically significant. The role of gender on choice of sanitation facility is not conclusive. The KIHBS 2016 survey data was the most the up to date at the time of study, additionally the study model's predictive accuracy was at 71.68 %; therefore, there is need for conducting a similar study with the most current data as soon as it is available to provide conclusive results.

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