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Effect of Poverty Status on Water, Sanitation, and Hygiene Behavior Among Oil-Palm Farming Households

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Abstract

This study evaluated the effect of poverty on water, sanitation, and hygiene behavior among oil palm farming households in Ondo State, Nigeria. Data were collected using a structured questionnaire administered to 150 households through a multistage sampling procedure. Descriptive statistics, multidimensional poverty index, WASH index, and ordered probit regression model were used to analyze the data. Results of the analysis showed that the majority (78.7%) of the oil palm farmers were male, most (62.7%) of them had secondary education, and the mean age was 50 years. About 94.7% lacked credit access, and 92.0% of the respondents were not members of cooperative associations. Results further revealed that 57.33% were multidimensionally poor, while 42.67% were not. Poverty incidence was 43.04%, exceeding the MPI of 24.67%. Contributions of each dimension to poverty include: health (4.13%), education (58.70%), and living standards (37.17%). Poverty, government intervention, and age significantly affected WASH status at 1%, 10%, and 5% levels, respectively. The level of disparity recorded in the analyzed result could be influenced by factors such as poverty status, government intervention, and age of the respondents, which were statistically significant in influencing their WASH behaviors at different levels. Results revealed that 28% of respondents were both multidimensionally poor and WASH poor. It is recommended that government and non-governmental organizations should develop and implement WASH programs that focus on improving access to clean water, sanitation facilities, and hygiene education that is specifically targeted at vulnerable groups, such as the elderly populations and low-income households. These will help reduce disparities in WASH outcomes and improve overall public health.

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Introduction

The cultivation of oil palm provides essential resources for producing cooking oil, soap, body creams, and biofuel [1], and it serves as a financial support system for many rural households [2]. Communities that engage in its cultivation often experience poverty rates lower than national averages [3]. Poverty is a complex issue, encompassing poor health and education, limited access to clean water and sanitation, inadequate physical security, and a lack of opportunities for a better quality of life [4]. It remains a global challenge [5], prompting the United Nations to commit to eradicating poverty in all its forms by 2030 [6]. In Africa, poverty manifests through poor living standards, inadequate education, and limited access to health facilities [7]. The adverse effects of poverty range from social exclusion, deprivation, and distress, which further deepen inequalities among individuals [5, 8].

Water and poverty are deeply interconnected. Limited access to clean water and inadequate sanitation harm health, food security, and income-generating opportunities. Poverty reduction can improve access to reliable, clean water. Currently, half of the global population lacks proper access to safe drinking water, sanitation, and hygiene [9]. In Nigeria, WASH conditions remain poor, with only 10% of the population having access to comprehensive basic water, sanitation, and hygiene services based on global JMP standards. Rural areas experience three times the disadvantage compared to urban regions [10]. Achieving SDG 6 (ensuring the availability and sustainable management of water and sanitation for all) remains challenging due to widespread poverty. Low-income households struggle with access to improved water and sanitation facilities, reinforcing inequalities between the rich and the poor [11]. This highlights how essential services become a luxury for affluent households while poorer communities remain vulnerable to waterborne diseases.

Diseases spread through contaminated water remain a leading global cause of illness and death, emphasizing the necessity of clean water and proper sanitation [12]. Recognizing WASH as a basic human right that is critical to people's health, dignity, and overall well-being, as well as the health of the country due to the significant impact on the productivity and health of households, makes it a crucial driver of household welfare. It is a top priority for the Sustainable Development Goals (SDGs). This study aims to analyze the poverty status of oil palm farming households and evaluate the impact of poverty on the oil palm farming households' WASH status.

Methods

Study area

The study was conducted in Ondo State, Nigeria. The state is situated in the South-Western Zone of Nigeria, and it comprises 18 Local Government Areas. Geographically, it spans between longitudes 4°30' and 6° east of the Greenwich Meridian, and latitudes 5°45' and 8°15' north of the Equator. The state shares borders with Ekiti and Kogi States to the North, Edo State to the East, Oyo and Ogun States to the West, and the Atlantic Ocean to the South. It covers a land area of 14,788.723 square kilometers, and has a population of 3,460,877 [13]. The Ondo state experiences a tropical climate characterized by two main seasons: the rainy season (April–October) and the dry season (November–March). Temperature variations throughout the year range from 21°C to 29°C, with relatively high humidity. Annual rainfall differs from 2,000 mm in the Southern regions to 1,150mm in the Northern areas [14]. Ondo state is renowned as the largest cocoa producer in Nigeria, in addition to the cultivation of other cash crops such as rubber, cashew, kola nut, oil palm, etc. [13].

Data collection and sampling procedure

Primary data were used for this study. The data were obtained from a field survey through the use of a structured questionnaire and an oral interview schedule that was conducted to elicit responses from the respondents who were randomly selected from the target population. The target population of this study was oil palm farmers (Fig. 1). A multi-stage sampling procedure was adopted to select respondents for the study. In the first stage, three oil palm-producing Local Government Areas (LGAs) were purposively selected. In the second stage, five oil palm-producing communities were randomly selected from each local government area. In the Final stage, ten oil palm farming households were selected using the snowball sampling technique from each of the selected communities. Thus, a total sample of 150 oil palm farming households was used for this study.
Source: Megbowon, 2024.

Method of data analysis

Descriptive statistics, Multidimensional Poverty Index (MPI), Water, Sanitation, and Hygiene (WASH) Index and ordered probit regression models

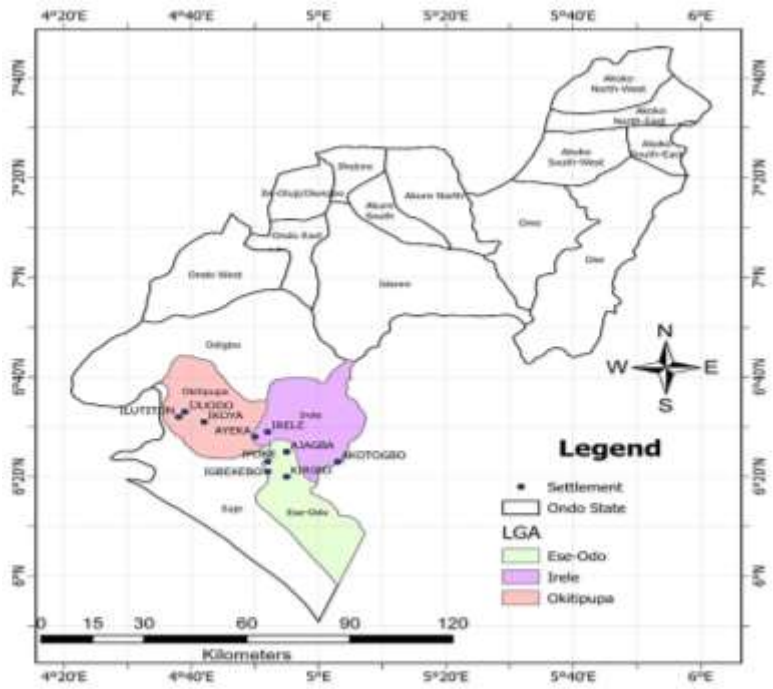

Fig. 1 Map of Ondo State showing the selected local government areas and communities.

were used for the analysis of data.

Descriptive analysis

The descriptive statistics, such as tables, frequency distribution, mean, and percentages, were used to describe and present the results of the findings of the socio-economic characteristics of the oil palm farming households, such as gender, age, marital status, educational qualification, household size, years of experience, access to credit, and type of toilet facilities used.

Multidimensional poverty index

The multidimensional poverty index (MPI) was used to analyze the poverty status of oil palm farming households in the study area. The multi-dimensional poverty index (MPI) assessed the total deprivations poor households experience into a set of indicators. The MPI combines two key pieces of information to measure poverty these are the incidence of poverty, or the proportion of people who experience multiple deprivations, and the intensity of their deprivation, which is the average proportion of weighted deprivations they experience. Based on the Alkire Foster methodology, it is calculated by multiplying the percentage of the population who are poor (poverty headcount) and the intensity of poverty. The first component is called the multi-dimensional headcount ratio (H), which is given by:

H = H (X; Z), which represents the proportion of the population that is poor and is defined as

$$H = q/n \text{ ---------- (i)}$$

Where q is the number of persons identified as poor using the dual cutoff approach. The dual cutoff considers

(i) whether the person is deprived in each of the dimensions and

(ii) a range of dimensions a person must be deprived of, to be considered poor.

The MPI is calculated in multiplicative form as:

$$MPI = H \times A \text{ ---------- (ii)}$$

Where H = the proportion of poor people or incidence of poverty

A = the average number of weighted deprivations experienced by the poor or the intensity of multidimensional poverty among the oil palm farming households.

Specifically, H measures the proportion of the sampled oil palm farming household population that experiences multidimensional poverty. It gives us an understanding of how many households are considered poor based on the multidimensional poverty indices. The result obtained from H will categorize the oil palm farming households into poor and non-poor. Households that experience deprivation in a minimum of one-third of the weighted multidimensional poverty indicators will be

Table 1 Attributes and scoring for water, sanitation, and hygiene behaviors.

Attributes	Scoring	Maximum Score
Water		
Water Source, Water storage, Water Treatment, Proper water usage, Low Cost of Accessing Water.	Not Available = 0, Available sometimes = 1, Always Available = 2	10
Sanitation and Hygiene		
Availability of soap, Waste Facilities, Food Hygiene, Toilet Facilities, Environmental Cleanliness	Not Available = 0, Available sometimes = 1, Always Available = 2	10
Total Score		20

Source: Authors Computation

considered poor. This means that an oil palm farming household will be considered multidimensionally poor if its weighted deprivation score equals or exceeds the poverty cutoff of 33.33%. A represents the average deprivation intensity experienced by households identified as multidimensionally poor, thereby providing information about the depth or severity of poverty among this specific group. A higher H indicates that a larger share of the population is facing multidimensional poverty, while a higher A suggests that a greater depth or intensity of poverty exists among those identified as multidimensionally poor. The MPI ranges from 0 to 1. A value of 0 indicates the absence of poverty, while a value of 1 signifies complete multidimensional poverty. Therefore, poverty intensity (A), which is the average deprivation score across the poor, can be written as:

$$A = \sum_{n=1}^{n} ci(k)q \text{ ---------- (iii)}$$

Where Ci (k) represents the share of possible deprivations experienced by a poor person I, and q is the number of multidimensionally poor people.

Water, sanitation, and hygiene (WASH) index

The Water, Sanitation, and Hygiene index was used to determine the level of compliance of the oil palm farming households to WASH behaviors, and this was constructed based on three key indicators: Water, Sanitation, and Hygiene of individual oil palm farming households. Each of these WASH indicators was scored for a number of attributes. The level of compliance among the oil palm farming households was analyzed by using the WASH index and categorized by adopting the composite indicator developed by [14] in his research Dietary Outcomes, Nutritional Status, and Household Water, Sanitation, and Hygiene (WASH) Practices. WASH behaviors of households were assessed through the determination of the level of WASH practices of each household by developing a WASH score of 16, which was stratified into quartiles of WASH practice: level 1 = poor WASH status; level 2 = fair WASH status; level 3 = good WASH status; and level 4 = very good WASH status. However, a WASH score of 20 was adopted for this study to capture relevant WASH behaviors of households with reference to the availability of such facilities within their vicinity. The WASH attributes were categorized into "available always, available sometimes, and not available" with corresponding scores of 2, 1, and 0, respectively (Table 1).

The attributes and the assigned scores are presented in Table 2 below. Table 2 presents detailed information on the attributes of Water, Sanitation, and Hygiene, and also the overview of all the attributes and scoring for the three indicators of WASH. The maximum score for all the attributes was 20. Thus, any respondent who was able to score a maximum for the entire score will score 20 points and hence 100%. Based on this scoring scheme, each of the respondent was scored on each of the WASH indicator and their attributes. The total score for each respondent was determined as the sum of all the scores. The percentage score (WASH Index) of each respondent was calculated as:

$$\frac{\text{Respondent's score}}{\text{Maximum score}(20)} \times 100 \text{ ---------- (iv)}$$

In determining the level of compliance for this study, the steps below were considered.

1. A total score for each respondent was calculated from each category.
2. Each respondent's total score was normalized to a scale of 0 to 1 by dividing by the maximum score (20).
3. Based on the normalized score, each household was grouped into highly compliant (0.76 – 1.00), moderately compliant (0.51 – 0.75), Low compliant (0.26 – 0.50), and non–compliant (0.00 – 0.25).

Ordered probit regression

Ordered Probit Regression was used to evaluate the effect of poverty status on the Water, Sanitation, and Hygiene behaviors of the oil palm farming households. An ordered probit model is a type of regression used when the dependent variable is ordinal, meaning that it represents categories with a clear order but no consistent distance between them.

This model is commonly applied in situations where the outcome variable is ranked, such as survey responses or variables that are in ordered categories**.** The dependent variable in an ordered probit model is ordinal. For example, in this research, WASH status was the dependent variable and was categorized into four categories, which were poor WASH status, Fair WASH status, Good WASH status, and very good WASH status, which were coded as 1, 2, 3, and 4, respectively [14]. The Ordered Probit model is a widely used approach to estimating models of ordered type, which almost employs the probit link function. There is a latent continuous metric underlying the ordinal responses observed by the analyst. The 3 latent continuous variables, Y*, are a linear combination of some predictors, X, plus a disturbance term that has a standard Normal distribution:

$$\gamma_i^* = X_i\beta + \epsilon \text{ ---------- (v)}$$

Where:

- γ_i^* is the dependent variable, which exhibits itself in ordinal categories
- X is a vector of independent variables.
- β is a vector of coefficients to be estimated.
- ϵ is the error term, assumed to follow a standard normal distribution.

The observed ordinal outcome γ is determined by the value of the latent variable Y* relative to a series of thresholds (τ) [15]:

$Y^* = 0$ if $Y^* \leq \delta 0$ ----------(vi)

$Y^* = 1$ if $\delta 0 < Y^* \leq \delta 1$----------(vii)

$Y^* = 2$ if $\delta 1 < Y^* \leq \delta 2$ ----------(viii)

$Y^* = 3$ if $\delta 2 < Y^* \leq \delta 3$----------(ix)

Where Y* (i=0, 1, 2) are the unobservable threshold parameters that were estimated together with other parameters in the model. When an intercept coefficient is included in the model, Y_0^* is normalized to a zero value [16] and hence only k-1 additional parameters are estimated with Xs. Like the models for binary data, the probabilities for each of the observed ordinal responses, which in this study had 3 responses (0, 1, 2), will be given as:

Prob (Y = 0) = P (Y* ≤ 0) = P (β'X + εi ≤ 0) = ø (-β'X) ……(x)

prob (Y = 1) = ø (δ1 - β'X) - ø (-β'X) prob (Y = 2) = 1- ø (δ1 - β'X) (3) where $0 < Y_1^* < Y_2^* < ... < Y^*_{k-1}$……. n is the cumulative normal distribution function such that the total of the above probabilities is equal to one. The specification of the ordered probit model is as follows. Let Yi denote the category – Very Good WASH status (4 = Yi), Good WASH status (3 = Yi), Fair WASH status (2 = Yi), Poor WASH status (1 = Yi) – to which the households belong. The above was adopted from [17].

Results and Discussion

The analysis of the age structure of the respondents shows that respondents between 31–45years constituted 38% of the total respondents, while respondents above 70 years constituted the lowest percentage of the respondents. This result implied that the majority (38%) of the oil palm farmers are older, likely due to the physically demanding nature of farming, which serves as the main source of household income. As a result of this, the farmers' capacity to manage and adopt new farming practices to earn more and move out of poverty will be highly affected as a result of the influence of age on their productive ability. The mean age of the respondents sampled in the study area was 50 years. This result aligns with the other findings, which reported that the mean age of oil palm farmers was 47 years. The result in Table 2 shows that the majority of the respondents were male. This result could be because of the labor-intensive nature of oil palm production, which requires a lot of manpower. The high percentage of married individuals (83.3%) in the workforce suggests a stable and dedicated labor force for oil palm production. Household size plays a key role in farm management and efficiency. The result of this study also showed that the mean household size of the respondents was 6. This suggests that oil palm farming households will enjoy consistent production due to the easy utilization of family labor in production activities to meet family annual expenditures. The highest level of education attained by the respondents (62.7 %) was secondary school, while the lowest was tertiary education (10.0%). This result is in line with the findings of [18], who stated that a primary level of education is crucial for effective participation in oil palm production. Higher education levels can impact farming by influencing technology adoption and can also influence effective WASH practices among households, which can lead to general improvement in their health and general well-being. The mean annual income was $576.86. This result opposes another finding [19], whose results revealed that the mean annual income from palm oil was $62.63. This result revealed that a larger percentage of the respondents earned a considerably high income from oil palm production. Farmers' use of credit can significantly boost their production. The results in Table 2 indicate that only 5.3% of the households have access to credit, with 8.0% being members of cooperatives. A varied distribution of sanitation facilities was recorded among respondents as a result. The analysis shows that 52.0% of the oil

Table 2 Socio-economic and demographic characteristics of respondents.

Socio-economic characteristics		Frequency (n = 150)	Percentage (%)	Mean
Age (Years)	<30	22	14.7	
	31 – 45	34	22.6	
	46 – 60	57	38	
	61 – 75	33	22	
	>75	4	2.7	
				50
Gender	Male	118	78.7	
	Female	32	21.3	
Marital Status	Single	17	11.3	
	Married	125	83.3	
	Divorced	5	3.3	
	Widowed	3	2.1	
Household size	1-3	27	18.0	
	4 – 6	91	60.7	
	7 – 10	32	21.3	
				6
Educational Qualification	No Formal Education	25	16.7	
	Primary	16	10.7	
	Secondary	94	62.6	
	Tertiary	15	10.0	
Farm Size(Ha)	<1	2	1.3	
	1 – 1.9	17	11.3	
	2.0 – 2.9	34	22.7	
	3.0 – 3.9	5	3.3	
	>4.0	92	61.4	
				4.97
Household Income ($)	0 – 200	42	28	
	200.1 – 400	20	13.4	
	400.1 – 600	30	20	
	600.1 – 800	17	11.3	
	>800	41	27.3	
				576.86
Access to Credit	Yes	8	5.3	
	No	142	94.7	
Membership of an Association	Yes	12	8.0	
	No	138	92.0	
Toilet Facilities	Water Cistern	78	52.0	
	Covered Pit Latrine	23	15.3	
	Uncovered Pit Latrine	8	5.3	
	Bush/Open Defecation	10	6.7	
	Toilet facilities shared with others	31	20.7	

Source: Computed from Field Survey, 2024.

palm farming households made use of water cisterns, while 15.3%, 5.3%, 6.7% and 20.7% use covered pit latrines, uncovered pit latrines, open defecation, and shared toilet facilities, respectively.

Toilet facilities used by respondents

The result in Table 3 showed a varied distribution of sanitation facilities among respondents. The result showed that 52.0% of the oil palm farming households made use of water cisterns, which are considered improved sanitation facilities. However, 15.3% used covered pit latrines, and 5.3% used uncovered pit latrines; 6.7% practiced open defecation, which poses significant health risks. Additionally, 20.7% used shared toilet facilities, which may present hygiene and privacy challenges. This result supports

Table 3 Distribution of respondents by type of toilet facilities used.

Toilet Facilities	Frequency	Percentage (%)
Water cistern	78	52.0
Covered pit latrine	23	15.3
Uncovered pit latrine	8	5.3
Bush/open defecation	10	6.7
Toilet facilities shared with others	31	20.7
Total	150	100.0

Source: Computed from Field Survey, 2024.

Table 4 Distribution of respondents by source of water.

Variables	Frequency	Percentage (%)
Unprotected well	2	1.3
Open springs	16	10.7
Surface water	42	28
Borehole	15	10
Fetching water from neighbors via payment	75	50
Others (rainwater)	0	0
Total	150	100

Source: Computed from Field Survey, 2024.

Table 5 Distribution of indicators of poverty affecting the oil palm farming households.

Indicators	Number of deprived respondents	Proportion of deprived respondents	Total deprivations
Health			
Nutrition	7	0.0467	1.1669
Child mortality	2	0.0133	0.3334
Education			
Years of schooling	61	0.4067	10.0020
School attendance	68	0.4533	11.3356
Living standards			
Electricity	86	0.4733	4.6704
Sanitation	37	0.2467	1.9460
Drinking water	39	0.2600	2.0572
Cooking fuel	37	0.2467	2.0572
Assets	12	0.0800	0.5560
Toilet facilities	42	0.2800	2.2240
Total			36.3487

Source: Computed from Field Survey, 2024.

the previous findings [20], who reported that the majority (39%) of his respondents who were residents in Ondo State made use of water closets. However, in this study, while the majority had access to improved sanitation, there remains a need to address the issues associated with the use of uncovered pit latrines and open defecation.

Water sources used by respondents

The result in Table 4 shows that 12% of the oil palm farming households rely on unprotected wells, 10.67% on open springs, 28% on surface water, 10% on boreholes, and none rely on other sources. The largest percentage of the oil palm farmer's constituting 50% spend money to get water to cater to the needs of their families. The result of this analysis revealed that several farming households still lack access to safe, clean, and potable water.

Indicators of poverty affecting respondents

In a sample of 150 oil palm farming households, analysis of each indicator of poverty in Table 5 revealed significant deprivations experienced by each household. This includes 47.33 % in electricity, 28% in toilet facilities, 26% in drinking water, 40.67% in years of schooling, and 45.33% in school attendance. Nutritional issues and child mortality affected only 4.67% and 1.33% of the respondents, respectively. In addition, cooking fuel, assets, and sanitation account for 24.67%, 8% and 24.67% respectively. The economic implication of this finding is that respondents may find it more difficult to live a healthy and economically productive life. Poor school attendance can also result in child labor, which

lowers a child's potential for future earnings and may lengthen their household's cycle of poverty. In order to boost economic productivity, health, and general well-being, it is necessary to address these gaps if the oil palm farming households are to break the cycle of poverty. Table 4.13 revealed that it is necessary for the oil palm farming households to require about 43.02% additional efforts to be put in place if they are to break the cycle of poverty. The findings of other researchers [21], differ from the findings of this study. The results of the study showed that the highest form of deprivations affecting households were related to child school attendance, asset ownership, and child mortality; these factors had the most detrimental effects on living standards, healthcare, and education.

Dimensions of poverty affecting the oil palm farming households

The various dimensions of poverty in Table 6 that contributed to the overall poverty status of the respondents provided an analysis of multidimensional poverty across the three key dimensions of Poverty, which are: Health, Education, and Living Standards. Each dimension is equally weighted, contributing 33.33% each to the overall Multidimensional Poverty Index (MPI). The overall MPI in Table 6 was calculated to be 24.68% which is contrary to the previous findings [22], who reported that multidimensional poverty among rural households in South-West Nigeria was 40.1%. The incidence of poverty (H), also known as the multidimensional headcount ratio, was 0.5733, which implies that 57.33% of the respondents live with a malnourished person, have no access to clean drinking water, electricity, education, good housing, toilet facilities, and cooking fuel. The intensity of poverty (A), accounting for 43.04% suggests severe poverty, as it is higher than the observed MPI of 24.67%. The low standard deviation (0.08095) and variance (0.0066) revealed that poverty was relatively consistent across the sample, showing minimal variability in deprivation among oil palm farming households in the study area.

The health dimension showed a low percentage of deprivation of 4.13%. This result implies that although health contributes to the overall MPI, it is not the primary driver of poverty among respondents in the study area, which indicates that the majority of the respondents had access to basic health care services and improved healthcare results. Education emerges as the largest contributor to the multidimensional poverty of respondents, with a high percentage of deprivation of 58.70%. This revealed that a larger percentage of the deprived households experience deprivation in the indicators related to education and are deprived of adequate educational opportunities. These findings may be a result of factors such as low levels of educational attainment, lack of access to schools, or inadequate educational resources. In addition, the result also showed that educational deficiencies are a major factor in the overall poverty experienced by the oil palm farming households. This justifies the need for urgent policy intervention to improve educational access and accomplishments. The living standards also contributed substantially to the MPI, with a percentage deprivation of 37.17%. This result revealed that the significant deficiencies experienced by respondents include access to basic living conditions, such as clean water, electricity, sanitation, toilet facilities, cooking fuel, and assets. This level of deprivation showed that a considerable number of the respondents lacked access to essential services, which contributed to their overall poverty status.

Poverty status of the oil palm farming households

The result of the analysis in Table 7 showed that 57.33% of the households were multidimensionally poor. This reveals the multiple deprivations they experience as a result of a lack of essential and basic hygiene and sanitation services. A lower percentage of the respondents (42.67%) were not multidimensionally poor (non–poor). This distribution suggests that a substantial proportion of the oil palm farming households in the study area are still living in poverty. This reflects the remarkable challenges faced in accessing essential resources.

WASH index, WASH status, and the level of compliance of respondents

The result in Table 8 showed that 36% of the respondents had very good WASH status, which showed the relatively high standards of Water, Sanitation, and Hygiene compliance level of the households. About 30% of the sample households had good WASH status and a moderate level of compliance; this result revealed that although their status was good, there is still room for improvement. This may reflect the effectiveness of local interventions or natural environmental advantages in the selected communities. About 18.67% had fair WASH status. Beneficial efforts aimed at improving the availability of WASH facilities could be made available for these categories of farmers with fair WASH status. This segment of the sampled

Table 6 Distribution of dimensions of poverty affecting the oil palm farming households.

Dimensions	Weighted score (%)	Total deprivations	Deprivation (%)
Health	33.33	1.5003	4.13
Education	33.33	21.3376	58.70
Living Standards	33.33	13.5108	37.17
Total		36.3487	100.0
Mean			0.4304

Median = 0.4446; Standard Deviation = 0.08095; Variance = 0.0066
MPI = 24.68%; H = 57.33%; A = 43.04%
Source: Computed from Field Survey, 2024.

Table 7 Distribution of the oil palm farming households by poverty status.

Poverty Status	Number of deprived respondents	Percentage of deprived respondents (%)
Poor	86	57.33
Non-poor	64	42.67
Sum	150	100.0

Source: Computed from Field Survey, 2024.

Table 8 Percentage distribution of categorized wash index, wash status, and level of compliance of respondents.

WASH index	Level of compliance	WASH status	Total	Percentage (%)
0.00 – 0.25	Non –compliant	Poor	23	15.33
0.26 – 0.50	Low compliant	Fair	28	18.67
0.51 – 0.75	Moderately compliant	Good	45	30.00
0.76 – 1.00	Highly compliant	Very Good	54	36.00
Total			150.0	100.0
Mean				0.62

Median = 0.55; Mode = 0.55; Standard Dev.= 0.26; Variance = 0.07
Source: Computed from Field Survey, 2024.

Table 9 Categorization of households based on their wash status and poverty status.

Category	Frequency	Percentage (%)
Multidimensionally poor and WASH poor	42	28
Multidimensionally non-poor and WASH status poor	7	4.67
Multidimensionally poor and WASH status non-poor	44	29.33
Multidimensionally non-poor and WASH status non-poor	57	38
Total	150	100.0

Source: Computed from Field Survey, 2024.

households was low in their level of compliance with WASH behaviors. In addition, 15.33% had poor WASH status among the households, which revealed that a few households experienced extremely poor WASH conditions. Hence, they are "non–compliant". This may reflect the ineffectiveness of local interventions or natural disasters in the selected communities. The average WASH index was 0.6237, which indicates that the overall WASH status of the respondents skewed towards "Good WASH status and Highly Compliant category". This category is also predominant among the respondents, as the modal value of 0.55 was obtained from analyzing the results. The moderate variance (0.0684) observed in the WASH Index revealed some level of disparity in the WASH conditions of the oil palm farming household. This level of disparity could be influenced by factors such as household income, education, geographical location, household size, etc. From the analysis of the WASH behaviors of the oil palm farming households, are we sure that we will be able to achieve SDG 6.1 and 6.2 by 2030? Further research on these variables is required to better understand the underlying causes of this variability and to develop more targeted interventions.

WASH status and poverty status of respondents

Table 9 revealed that 28% of respondents are both multidimensionally poor and WASH poor, indicating severe vulnerabilities. While 38% enjoyed good conditions in both areas, 29.33% were poor but had adequate WASH status, showing some resilience. A small percentage, accounting for 4.67% of the respondents, were WASH poor despite not being multidimensionally poor. This result showed the gaps in WASH access by the respondents.

Table 10 Effect of poverty status on WASH behaviors of oil palm farming households.

Variables	Coefficients	Standard error	z- value
Poverty status	1.1513	0.2117	5.44***
Household size	-0.0205	0.0566	-0.36
Marital status	-0.0986	0.2217	-0.44
Government intervention	0.6756	0.3510	1.92*
Gender	0.0124	0.2462	0.05
Years of education	-0.0578	0.0910	0.63
Age	0.0269	0.0117	2.30**
Household income	2.99e-07	3.05e-07	0.98

(*), (**), (***) Indicates level of significance at10%, 5% and 1% respectively
Log likelihood = -169.87 Prob > chi2 = 0.0000
Source: Computed from Field Survey, 2024.

Table 11 Marginal effect of socio-economic variables on the oil palm farming households' WASH status.

WASH status	Very good WASH status		Good WASH status		Fair WASH status		Poor WASH status	
Variable	dy/dx	z-Value	dy/dx	z-Value	dy/dx	z-Value	dy/dx	z-Value
Poverty status	-0.4128	-5.80***	0.0519	1.43	0.1781	4.32*	0.1829	4.52***
Household size	0.0075	0.36	-0.0005	-0.32	-0.0035	-0.36	-0.0035	-0.36
Marital status	0.0359	0.44	-0.0024	-0.37	-0.0168	-0.44	-0.0167	-0.44
Government intervention	-0.2103	-2.37**	-0.0429	-0.79	0.0968	2.39**	0.1564	1.51**
Gender	-0.0045	-0.05	0.0003	0.05	0.0021	0.05	0.0021	0.05
Years of education	0.0068	0.67	-0.0005	-0.48	-0.0032	-0.67	-0.0032	-0.67
Age	-0.0098	-2.28**	0.0007	0.67	0.0046	2.14**	0.0046	2.18**
Household income	-1.09e-07	- 0.98	7.33e-09	0.57	5.10e-08	0.97	5.05e-08	0.97

(*), (**), and (***) Indicates 10%, 5% and 1% level of significance respectively.
Source: Computed from Field Survey, 2024.

Effect of poverty status on WASH behaviors of oil palm farming households

The result in Table 10 revealed that poverty status, government intervention, and age of household members were statistically significant in influencing the WASH behaviors of the oil palm farming households.

Marginal effect of socioeconomic variables on the oil palm farming households' WASH status

The result in Table 11 revealed the estimated effect of poverty status on the Water, Sanitation, and Hygiene behaviors of oil palm farming households using ordered probit regression. The result obtained revealed that poverty status, government intervention, and age of household heads were statistically significant in influencing their WASH behaviors at different levels. Being a poor household reduces the probability of having a very good WASH status by 0.4128. However, it increases the probability of having a fair WASH status and a poor WASH status by 0.1781 and 0.1829, respectively. This is because poor and vulnerable populations have lower access to improved WASH services [23]. In addition to the findings above, the result of the analysis showed that none of the independent variables affected the households with good WASH status. Government intervention reduces the likelihood of having a very good WASH status by 0.2103 and increases the probability of having a fair and poor WASH status by 0.0968 and 0.1564, respectively. This could be as a result of inefficient allocation of resources, corruption and leakages, and inadequate monitoring and evaluation. Age and gender are important factors that influence who can practice WASH behaviors at household levels [23]. Although the result shows that advancement in age decreases the probability of households having very good WASH behavior by 0.0098, this decrease could be as a result of physical limitations due to health complications as a result of old age, dependency on other members of the household for daily needs, and adherence to certain traditional practices that can have a negative impact on their WASH behaviors. Age also increases the likelihood of oil palm farming households to have a fair WASH behavior by 0.0046. This could be because older people tend to bring experience, health awareness, and leadership in every area within the households, thereby promoting better WASH behaviors. In addition, the age of household heads had a significant effect on households with poor WASH behavior, which could also be a result of a lack of formal education, limited allocation of

resources, and influence on household decision-making.

Conclusion

The predominance of middle-aged male household heads who were married, educated, and with a mean annual income of $655 clearly indicates that households have greater financial capacity to invest in improved WASH behaviors, such as access to clean water, proper sanitation, and hygiene facilities. This level of income increases the likelihood of adopting practices that directly contribute to better health outcomes and reduced risk of waterborne diseases, productivity, and overall well-being. The extent of WASH outcomes is strongly influenced by gender roles and household decision-making dynamics, as these factors directly shape how WASH priorities are set, resources are allocated, and behaviors are adopted within the home. More than half of the respondents were multidimensionally poor. This emphasizes that a considerable number of the respondents lack essential services, which contributes to their overall poverty status. The level of disparity recorded in the analyzed result could be influenced by factors such as household income, education, geographical location, and household size. Furthermore, poverty status, government intervention, and age of the respondents were statistically significant in influencing their WASH behaviors at different levels. In conclusion, this research provides a valuable insight into the WASH conditions of oil palm farming households by revealing the level of access to each WASH facility and offers knowledge that will inform policy development that is aimed at alleviating poverty and enhancing WASH practices.

Recommendations

In order to achieve the objectives outlined in SDG 6.1 and 6.2, the following recommendations should be considered for policy development. Non-governmental organizations should develop and implement WASH programs, which focus on improving access to clean water, sanitation facilities, and hygiene education that is specifically targeted at vulnerable groups, such as the elderly populations and low-income households. These will help reduce disparities in WASH outcomes and improve overall public health. Community leaders should encourage their subjects to embrace WASH practices individually and collectively through the creation of cooperative societies that focus on the provision of education, training on proper hygiene practices, and the importance of sanitation. Households should adopt simple, low-cost WASH facilities, such as the utilization of locally made water filters, practicing safe water storage, constructing affordable latrines, and producing soap from locally available materials.

Local government authorities should make relevant water drilling equipment available to residents so that they can make use of it to acquire good potable water facilities and improve accessibility to water by households. Primary health care staff should be saddled with the responsibility to carry out robust health education and health awareness programs to households at the grassroots level. They can also meet with relevant association bodies within the community on their meeting days to carry out this health extension exercise effectively. The local government authorities should address the issue of lack of power sources by helping to reconnect electricity back into the communities to enhance easy access to cheap, effective, and affordable WASH facilities for households. Community leaders should seek assistance from the local government authorities in facilitating the availability and accessibility of WASH facilities in the community. Further studies should be conducted in order to identify the determinants of the variability in WASH status and to explore the impact of WASH improvements on overall health outcomes.

Conflict of interest

The authors declare no conflicts of interest.

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