

## Assessing the Planning Indicators for Open-Defecation Prevention in Ogun State Nigeria

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Received: 22/5/2022

Revised: 26/6/2022

Accepted: 10/7/2022

This study is aimed at employing the structural equation model to estimate the significance of effective management of toilets, interventionist measures, and punitive measures, as veritable dimensions of planning that can mitigate open defecation in Ogun state, Nigeria. Adopting a four-level multi-stage approach, a total of 110, 100, and 120 questionnaires were respectively administered in Ogijo/Likosi, Ilaro I, and Sodeke/Sale-Ijeun I wards. The selected criteria reflect the variance in the populations of 1,250,435(33%), 1,112,761(30%), and 1,387,944(37%) for Ogun East, Ogun West and Ogun Central, respectively. The pooled confirmatory factor analysis process involved several re-estimations, based on the deletion of lowly loading factors and correlation of redundant items. Next, the model was validated; normality was assessed; and full structural model was analysed. The structural model established a significant positive relationship between Effective Management of Toilets (MT) and Planning Dimension (PD) ( $\beta=0.773$ ,  $p<0.05$ ), Punitive Measures (PM) and Planning Dimension (PD) ( $\beta=0.765$ ,  $p<0.05$ ), and similarly, Interventionist Measures (IM) and Planning Dimension (PD) ( $\beta=1.093$ ,  $p<0.05$ ). The study, among all others, recommends the implementation of initiatives such as landscaping of open spaces; provision of bus terminals with adequate toilets, in the event that households members are pressed while travelling; installations of signposts warning against open defecation; connection of all residential developments to comprehensive water schemes; and enlightenment campaigns against open defecation by the authority, as planning measures that can discourage open defecation.

**Keywords:** Interventionist measures, modelling, open defecation, punitive measures, planning

### INTRODUCTION

The rate of open defecation in Nigeria has remained steady, with 46 million Nigerians still defecating in the open (Njoku, 2021). This makes the number of open defecators per square kilometre in Nigeria to be about 50 per square kilometre. Studies that show the immense value of reuse and recovery of faecal waste offer incentives to voluntary investment in the construction of households' toilets continue to gain traction in environmental studies (Andersson *et al.*, 2016; Afolabi *et al.*, 2017; Danso *et al.*, 2017; Rao *et al.*, 2017). Yet there are issues bordering on

social acceptability, culture, awareness, technology, and environmental factors, which Olapeju *et al.* (2020) had attempted to investigate in a bid to determine the practicality of reuse and recovery as a viable strategy for incentivising toilets construction and ultimate mitigation of open defecation.

However, it must be stressed that reuse and recovery would not suffice in comprehensively mitigating a planned behaviour like open defecation. For instance, households, including those having toilets in their homes sometimes, defecate in the open whenever they are pressed, and not at home, and the

plausible reasons for such behavior are lack of public sanitary facilities; lack of bus terminals, which can afford commuters the opportunity to, at specific hourly intervals, alight from their buses to ease off in designated toilets within the terminals; proximity of unkempt bushes to built-up areas; poor environmental illumination due to constant electricity shortages; and the messy condition of toilets, when available, lack of signposts warning against open defecation and lack of punitive consequences for people that defecate in the open, among others. These actually require planning measures, in terms of policies and proactive spatial planning, more than emphasis on reuse. This study is aimed at employing the structural equation model to estimate the significance of effective management of toilets, interventionist measure, and punitive measures, as veritable dimensions of planning that can mitigate open defecation in the study area.

### RESEARCH METHODOLOGY

The study adopted the convergent parallel variant of the mixed-mode

technique, which involves the conflation of quantitative and qualitative method of data collection. For the quantitative element, the multistage approach, in a four level manner, was adopted. This is inclusive of all political divisions in the study area. Foremost, Ogun State is shown as one of the 36 states in Nigeria. Ogun state was classified on the basis of its three main senatorial districts, which are Ogun Central Senatorial District, Ogun East Senatorial District, and Ogun West Senatorial District. These geographical groupings represent the three major regional divisions within the State. Further, Ogun East Senatorial District consists of nine local governments, which are: Ogun Waterside, Ijebu East, Odogbolu, Ijebu North, Ikenne, Ijebu North-East, Ijebu-Ode, Sagamu, and Remo North. Yewa North, Ado-Odo/Ota, Yewa South, Ipokia, and Imeko-Afon are the five local governments in Ogun West Senatorial District. Moreover, Ogun Central Senatorial District encapsulates six local governments, which are: Odeda, Obafemi/ Owode, Abeokuta South, Abeokuta North, Ewekoro and Ifo.



**Figure 1:** Map of Ogun State

In the second stage, the random selection of Sagamu, Yewa South, and Abeokuta South Local Governments as the sampling Local Governments in Ogun East Senatorial District, Ogun West

Senatorial District, and Ogun Central Senatorial District, respectively was done. The third stage involves the random selection of a representative ward, based on the wards and polling unit

delineations of Independent National Electoral Commission (INEC), from each of the sampling Local governments. In Sagamu Local Government, which consists of 15 political wards namely: Oko/Epe/Itula I; Sabo I, Oko/Epe/Itula II; Sabo II; Ayegbami/Ijokun; Isokun/Oyebajo; Ijagba; Ode-Lemo; Latawa; Ogijo/Likosi; Simawa/Iwelepe; Surulere; Isote; Ibido/Ituwa/Alara, and Agbowa, Ogijo/Likosi ward was randomly selected as the sampling ward. Out of the 10 political wards in Yewa South, namely Ilobi/Erinja, Ilaro I; Iwoye; Ilaro II; Idogo ; Ilaro III; Owode I; OkeOdan; Owode II; and Ajilete, Ilaro I was randomly selected as the sampling ward. Further, Sodeke/Sale-Ijeun II was randomly selected as the sampling ward in Abeokuta South Local Government, which encapsulates 15 political wards, namely, Ake I; Keesi/Emere; Ijemo; Ake II; Ake III; Itoko; Erunbe/OkeIjeun; Ijaye/Idi-Aba; Sodeke/Sale-IjeunI; Ago-Egun/Ijesa; Sodeke/Sale-Ijeun II; Imo/Isabo; Igbore/Ago Oba; Ibara I; and Ibara II.

The fourth stage involves the random selection of polling units in each sampling ward, and the random selection of buildings occupying targeted households and locating within 1 kilometre radius from the polling units. The polling units are nationally recognized landmarks for further categorising spatial entities into smaller homogenous units. All the polling units in each of the sampling wards were identified. In Ogijo/Likosi ward, out of the available 19 polling units, 10 namely: St Paul's School Igbode; U.A.M.C School Iraye; St Micheal RCM Fakale; LG school Erefun; St Francis school Igbosoro; St John school Ogijo I; LG School Igbaga;

Wesley School Sotunbo; A.U.D School Imushin-Ogijo; and CAC School Ogijo I, were randomly selected. In Ilaro I, out of the available 17 polling units, 10 namely : State hospital; Idowu's house(Otegbeye street); Opp Soyinka's house IU.A.M.C school Pahayi; Eleja(Oke-Ola); Poly gate; OritaKajola; Egbo Alaparun; Library/rural health care centre; and Italyalode, were randomly selected. In Sodeke/Sale-Ijeun II, out of the available 25 polling units, 10 namely: Onijoko Mosque OkebodeII; OppOke-Itoku Mosque II; Ile OgboniOkeItoku; Near Town Planning; Open space Ojulakijena; St Joseph RCM. Oke-bode I; Primary School I dipape I; All Saint School Kobiti; Open space Kemta Odutolu Mosque; and Opp. Bus Stop Bata Itoku, were randomly selected. This made the total number of polling units within the radius of which households were surveyed in the study area to be 30. Systematic random sampling approach on the basis of the 5<sup>th</sup> building interval was adopted in selecting 11 household administered questionnaires within 1 kilometre radius of each of the 10 randomly selected polling units in Ogijo/Likosi ward; 10 households administered questionnaires within 1 kilometre radius of each of the 10 randomly selected polling units in Ilaro I; and 12 households administered questionnaires within 1 kilometre radius of each of the 10 randomly selected polling units in Sodeke/Isale-Ijeun II. Systematic random approach adopted is to the extent of making the selection of households an entirely random process that disregards the arrangements and physical outlook of the buildings in a manner that can suggest the response patterns of households. The questionnaire

distribution ratio 1.1: 1.0: 1.23 adopted dovetails with the population variance across the three senatorial districts in Ogun state estimated as 1,250,435(33%), 1,112,761(30%), and 1,387,944(37%) for Ogun East, Ogun West and Ogun Central, respectively, as sourced from NPC (2010). This implies that 110, 100, and 120 questionnaires were administered in Ogijo/Likosi; Ilaro I, and Sodeke/Sale-Ijeun II, respectively, making a total of 330 households that were surveyed, which represents about 0.06% of the estimated 535,877 households in the study area. Households represent the unit of data collection, and the household heads were the respondents that gave information about their households. The actual quantitative survey was conducted within the first 3 months of the 4 months and two weeks allocated for data collection in the research schedule. Public holidays, mostly Saturdays, for religious neutrality, were selected as the visitation days for household surveys. This is to ensure high response rates, prevent the disruption of the systematic random approach and the attendant introduction of sampling error that can be caused by respondents' absence, as most potential respondents will be at home on Saturday. The qualitative data adopted the interview approach. The interviews were conducted within the last month of the 4 months and two weeks allocated for data collection in the research schedule. It involved the adoption of flexible semi-structured instrument to interview key informants, which are knowledgeable in key aspects of the research. Data collected for this study was checked for errors, and necessary corrections made. Coding of variables as well as classification of data was equally carried out to facilitate analysis. Missing data were adequately taken care of, as the face-to face questionnaire administration method adopted by the study through well trained survey assistants ensured the

minimization of missing data. Missing cases only effectively existed in variables expecting responses from exclusive groups, for instance households that use a specific faecal waste management means. However, the exclude cases pair wise option adopted ensured that all observations to the extent that they have necessary information were included in the analyses. In the course of analysis, outliers not exceeding the 3-box lengths from the edge of the plot box were retained, while the values of the extreme cases were changed to less extreme values in a manner that does not distort the originality of the statistics. SPSS was deployed in determining the reliability and execution of exploratory factor analysis of the study's major constructs. The construct Effective Toilet Management, is being measured by indicators such as cleanliness; water availability; constant latrines' emptying; lesser pressure on toilets (invariably more toilets); and illumination of toilets environs, especially at nights, can encourage households not to defecate in the open. Furthermore, interventionist measures is defined by items such as availability of clean public toilets; planning and landscaping of open spaces; provision of bus terminals with adequate toilets, in the event that households members are pressed while travelling; installations of signpost warning against open defecation; and enlightenment campaigns against open defecation by the authority, can enhance their sanitary responsibility, especially with respect to open defecation. The punitive measure is defined by indicators such as getting whoever is caught openly defecating to clean his or her mess; ostracization of open-defecators; payment of fines by whoever is caught openly defecating; and placement of cultural or religious curse on open defecators. However, in order to assess the validity of the constructs influencing faecal waste reusability in the study area, independently, through the

confirmatory factor analysis (CFA), Analysis of Moment Structure (AMOS) was used to develop the best fit indices and construct validity.

**RESULTS**

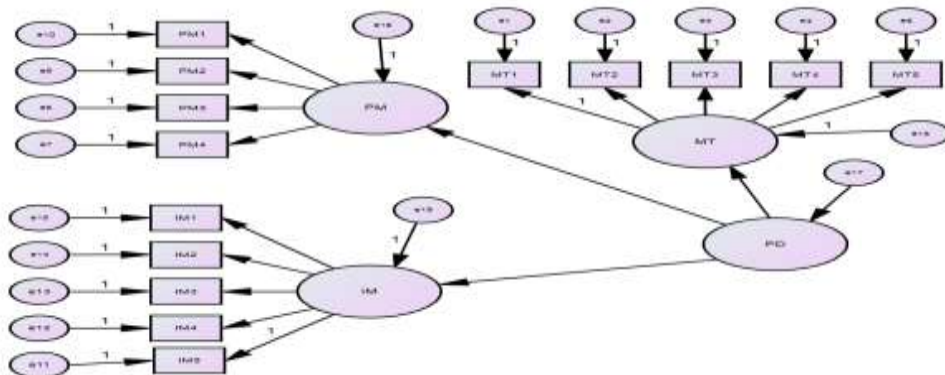
**Reliability and Validity Tests**

All the constructs met up with requirement of reliability test, which was conducted to measure the degree of internal consistency of the research instrument’s scale. The Cronbach Alpha test suggests the goodness of internal consistency for items, and the acceptable benchmark is 0.7 and above (DeVellis, 2003). Moreover Exploratory Factor Analysis (EFA) was employed to determine the extent to which measures effectively underpin their underlying constructs. For EFA, items with factor loadings of less than 0.4 are expected to be deleted (Hair *et al.*, 2006; Paschke, 2009). For all the three constructs,

Effective Management of Toilets, Interventionist Measures and Punitive Measures, all items loaded above 0.4. Kaiser-Meyer-Olkin (KMO), which represents the measure of sampling adequacy at the value of 0.81 is acceptable, as it crossed the 0.5 cut-off value

**Structural Equation Modelling Analysis and Interpretation of the Significant Planning Factors for Open-Defecation Prevention**

The pooled measurement model is a second-order-construct that premises planning dimension to open defecation prevention (PD) on three constructs. Structural Equation Modeling adopting the AMOS version 22 was used to validate the hypothesized measurement model of the Effective Management of Toilets, Interventionist Measures, and Punitive Measures, as veritable dimensions of planning that can mitigate open defecation.



**Figure 2: Hypothesized Measurement Model using Pooled CFA Estimates**

The sub-construct –Effective Management of Toilets (MT) contains five measuring items namely, MT1 – MT5. Five items, namely IM1- IM5 measure the sub-construct-Interventionist Measures (IM). Moreover, Punitive Measures was measured with six items, namely, PM1 – PM4.

**Confirming the Measurement Model Using Pooled Confirmatory Factor Analysis (PCFA)**

This study adopted the pooled CFA to validate the hypothesized model. This study, following Jonathan (2016) and Ndalai (2017), adopts RMSEA and GFI as the fitness indexes from the absolute fit category; CFI, TLI, and NFI from the incremental fit category. For the

parsimonious fit category, the chi-square/df index was selected. The outcome of the pooled measurement model at RMSEA = 0.178; GFI = 0.732, TLI = 0.678, NFI = 0.732, CFI = 0.739 and Chisq/Df = 27.658, were grossly inadequate, and necessitates improvement.

### **Improving the Model Fitness**

In order to improve the model's fitness indices, all constructs and items with low factor loadings were expunged from the model. This is in line with Zainudin (2015) that items or first order constructs with factor loading less than 0.5 are considered poor and should be deleted from models. In light of this, one item PM 4 with a low factor loading (0.461) was removed, after which the model was re-estimated. After the re-estimation based on low factors removal, only two fitness indexes, NFI and CFI, at 0.754 and 0.760, respectively, achieved their required fitness levels, despite all items loading above 0.5. The RMSEA (.181), GFI (0.748), TLI (0.698), and CMIN/Df (28.516) values did not achieve their required level of fitness.

### **Modification Indices (MI)**

Considering the fact that fitness indexes were not achieved with the removal of items and constructs with low factor loadings, recourse was sought to modification indices. This is in view of the likelihood of redundant items in the model. As recommended by Zainudin (2015), the options available under modification indices is either the deletion of redundant items or the setting of items with the highest modification indices/per change as free parameters by correlating the errors. For this study, the latter option was repeatedly adopted till fitness indexes were achieved. Foremost, e10 and e12 were correlated. Model fitnesses were not achieved. This was followed by subsequent correlations of e13 and e14; e11 and e12; e1 and e9; e8 and e14; e5 and e15; e3 and e4; e5 and e18; e9 and e13, e5 and e10, and e1 and e15; of e9 and e15; e14 and e15; e4 and e15; e8 and e12; e3 and e12; e4 and e11; e2 and e11; e4 and e5, e4 and e14, and e12 and e15; e8 and e10; e5 and e11; e4 and e12; e4 and e16; e5 and e14; e9 and e14; e2 and e10, until all fitness indexes, (RMSEA = .047; GFI = .987, TLI = .979, NFI = .987, CFI = .991 and Chisq/Df = 2.884) were achieved.

**Table 1: Statistics Proposed Model for Significant Factors of Planning Dimension after Errors with the Highest Modification Indices Have Been Correlated**

Model Identification			Model Fit Statistics			
Number of distinct	=	91	RMSEA=	.047	NFI=	0.987
Number of distinct parameters	=	58	GFI=	.987	CMIN/Df=	2.884
Degrees of freedom	=	33	TLI=	.979	CFI=	0.991
Model is identified						
Factor Loadings						
	Variable	SE	CR	p	SMC	Comment
MT	<--- PD	.773	16.508	***	.597	Convergence
IM	<--- PD	1.046	16.632	***	1.093	Convergence
PM	<--- PD	.765			.585	Convergence
MT1	<--- MT	.770			.594	Convergence
MT2	<--- MT	.871	25.359	***	.760	Convergence
MT3	<--- MT	.637	18.389	***	.406	Convergence
MT4	<--- MT	.605	17.472	***		Convergence
MT5	<--- MT	1.020	19.785	***	.271	Convergence
PM3	<--- PM	.775	19.236	***	.601	Convergence
PM2	<--- PM	.732	18.730	***	.536	Convergence
PM1	<--- PM	.811			.658	Convergence
IM5	<--- IM	.723			.523	Convergence
IM4	<--- IM	.718	24.507	***	.515	Convergence
IM3	<--- IM	.843	23.920	***	.711	Convergence
IM2	<--- IM	.707	19.657	***	.500	Convergence
IM1	<--- IM	.698	19.694	***	.486	Convergence

**Validating the Measurement Model**

The model’s construct was validated via the assessment of unidimensionality, validity, and reliability. Unidimensionality had been attained following the removal of the low factor items and constructs, and correlation of errors with high modification indices, the output of the model re-estimation indicates the achievement of all fitness indexes. Validity verification took the forms of convergent validity, construct validity and discriminant validity. Convergent validity was achieved with Average Variance Extracted (AVE) of

every construct estimated to be above 0.5. Construct Validity was attained with the adequacy of fitness indexes for each of the constructs. For this study, discriminant validity assessment is shown in Table 2. The AVEs, which measure the variance between constructs and their items, are indicated by the diagonal values in the table, and the other values indicate the correlation between constructs. The result showed that the square roots of AVE of constructs EC and EV are greater than the correlations among constructs them.

**Table 2: Discriminant Validity Index Summary**

Construct	MT	PM	IM
MT	<b>0.798</b>		
PM	0.139	<b>0.798</b>	
IM	0.117	0.114	<b>0.748</b>

**Reliability**

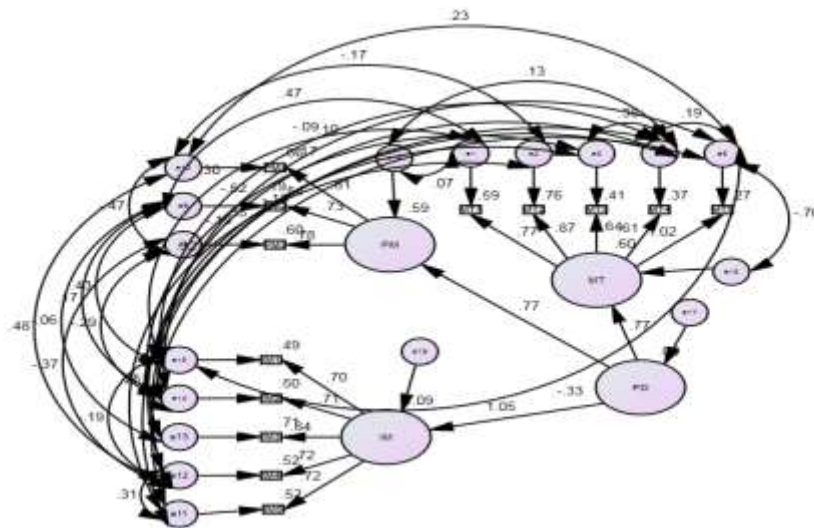
Two criteria are essential in the assessment of reliability of any measurement model: Composite Reliability and Average Variance Extracted. According to Zainudin (2015), a standardized value of CR of  $\geq 0.600$  is required for the attainment of composite reliability of latent constructs. All the constructs in the measurement model have composite reliability values that cross the 0.6 benchmark and can therefore be deemed adequate. Similarly, for Average Variance Extracted (AVE), Zainudin (2015) recommends that the AVE value  $\geq 0.500$  is the optimal requirement for all constructs in a measurement model. The AVE values for the measurement model constructs exceed the 0.5 mark and can therefore be deemed adequate.

**Assessment of Normality Distribution of Items in the Overall Model**

Normality is generally assessed by the skewness measure of each model item. However, as expatiated in Zainudin (2015), the absolute value of skewness of 1.5, especially when sample size is above 200, indicates normality. This implies that all items in measurement model should have skewness values that are lower than 1.5. The absolute values of skewness of all the measurement model's items are below 1.5. This however indicates normality for the measurement model.

**The Structural Modelling Analysis**

The full structural model estimates for the model also affords the presentation of the constructs' squared multiple correlations and the standardized regression paths coefficients and their level of significance.



**Figure 3: The Structural Model Showing the Path of Interest to be tested**



In this study, as evident in the squared multiple correlations obtained, 60% ( $R^2=0.60$ ) of variation of planning dimension to open defecation prevention is essentially explained by Effective

Management of Toilet (MT). Equally, 60 % ( $R^2=0.60$ ) of the variation of planning dimension to open defecation prevention can be explained by Punitive Measures (PM).

**Table 3: Constructs’ Regression Path Coefficients and their Significance and Squared Multiple Correlations ( $R^2$ ) of Measurement Model**

Construct	Path	Construct	Actual Beta Values	SE	Critical Ratio	p	SMC	Comment
MT	<---	PD	0.773	0.046	16.508	***	0.60	Convergence holds
PM	<---	PD	0.765	0.049	16.632	***	0.60	Convergence holds
IM	<---	PD	1.093	0.000		***	1.09	Convergence holds

Moreover, as evident in the column labeled p in Table 3, the structural model established a significant positive relationship between MT and PD ( $\beta=0.773$ ,  $p<0.05$ ), PM and PD ( $\beta=0.765$ ,  $p<0.05$ ), and similarly, IM and PD ( $\beta=1.093$ ,  $p<0.05$ ). The model pointedly reveals that 0.773 increment in the value of MT would culminate in a unit increase in PD. It further indicates that the possibility of achieving the regression weight estimate of 16.508 standard error above zero (Critical Ratio) is lesser than 0.05. This implies that the beta coefficient of MT in the determination of PD is significant. Similarly, a unit increase in the tendency for faecal waste reuse would be a function of 0.765 increments in EC. The probability of achieving a critical ratio of 16.632 is less than 0.05, which also indicates the significance of EC in the prediction of RF.

**INTERPRETATION**

All the constructs, as evident in the structural equation modelling, reflect a high level of significance, and can be deployed synergistically to complement the reuse incentive in the holistic quest of eradicating open defecation. Most households, including those not deprived

of in-house sanitary facilities, whether on transit or outside their homes, for different purposes, sometimes, defecate in the open, whenever they are pressed. The plausible reasons for this behavior are lack of or inadequate public sanitary facilities; lack of bus terminals to ensure commuters traveling long journeys can at intervals alight from their buses to easing themselves in sanitary facilities within such terminals; proximity of unkempt bushes to built-up areas, poor environmental illumination due to constant electricity shortages; and the messy condition of toilets, whenever they are available. Hence, the need for the participatory approach employed in exacting the best ideas on how open-defecation can be prevented from the planning point of view from households, rather than just recommending measures for the households, based on the researchers’ world view or ideas from literatures. The people living in the study area, including those having toilets in their homes, like in most parts of Nigeria, sometimes, defecate in the open whenever they are pressed, and not at home, and the most cited reasons for such behavior are lack of public sanitary facilities; lack of bus terminals, which can afford commuters the opportunity to,

at specific hourly intervals, alight from their buses to ease off in designated toilets within the terminals; proximity of unkempt bushes to built-up areas; poor environmental illumination due to constant electricity shortages; and the messy condition of toilets, when available.

These actually require planning measures beyond the emphasis on reuse. The effective management of toilets measure (as measured by indicators such as cleanliness, water availability, constant latrines' emptying, lesser pressure on toilets (invariably more toilets), and illumination of toilets environs, especially at nights), and interventionist measures (as defined by items such as availability of clean public toilets, planning and landscaping of open spaces, provision of bus terminals with adequate toilets, in the event that households members are pressed while travelling, installations of signpost warning against open-defecation, and enlightenment campaigns against open defecation by the authority) gained greater acceptance from households as measures that can help change their obsession with open defecation.

Interviews conducted to directors of environmental sanitation departments in the study area, reveal that though the local government authorities have mandate over sanitation in their areas of jurisdictions, the local government administration in Ogun state have been emasculated to implement most measures aimed at eradicating open defecation most importantly in terms of initiating local plans and mustering the resources to implementing the plans. Moreover, the departments across the three regions where interviews were conducted are grossly understaffed, and essentially at the mercy of state governments. This constrains their ability to optimally monitor sanitation and intervene appropriately (Ogun State Government, Personal Communication, February 2019). However, the Ogun State's

Ministry of Environment has been synergising with the Rural Water Supply and Sanitation Agencies with the support of the UNICEF to intervene in sanitation through water access enhancement and provision of public toilets. The Federal Government of Nigeria has equally recently made a giant stride in the quest to eradicating open defecation by launching the Clean Nigeria Campaign which aims at eradicating open defecation in Nigeria by 2025. The strategies envisaged include using technology options to suit households' preferences and paying capability; developing and promoting a 'Sanitation Ladder' that would ultimately bring households to adopting safely managed sanitation systems; promoting low-cost and low-water consuming pour flush latrines; developing an appropriate alternate delivery mechanism and social marketing for sanitation; refocusing the triggering process under community-led total sanitation (CLTS), and adopt appropriate enlightenment strategies. Others are to address the special needs of semi-urban and urban areas; providing toilet facilities at public places; training of personnel and human resources development; administrative back up and coordination mechanism; and modification of the certification for open defecation and beyond.

## **CONCLUSION**

From the planning point of view, it is a consensus of the households, based on the preponderance of agreement that planning initiatives such as planning and landscaping of open spaces, provision of bus terminals with adequate toilets, in the event that households members are pressed while travelling, installations of signpost warning against open defecation, connecting all residential developments to comprehensive water schemes, and enlightenment campaigns against open defecation by the authority, would go a long way in discouraging

open defecation. Hence, these planning measures should be mainstreamed in cities' master plans of Ogun state and implemented effectively. At the point when the country's road map to open defecation eradication clearly espouses a tier inclusive approach in agenda implementation, it is imperative that the local government authorities are empowered technically, fiscally, and in terms of man-power requisite to effectively play their constitutional role towards achieving effective faecal waste management.

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