



## COMPARISON OF PUBLIC WATER CONSUMPTION BETWEEN GOVERNMENT PRE-PAID AND CONVENTIONAL METER USERS IN ABEOKUTA, OGUN STATE

OMOLABAKE. O. ODUGUWA, OLASUMBO MARTINS AND  
OLUFEMI A. IDOWU

*Department of Water Resources Management and Agrometeorology,  
Federal University of Agriculture, Abeokuta, Ogun State, Nigeria  
Corresponding author: olufemidowu@gmail.com, +2348052577235*

### ABSTRACT

*Ogun State Water Corporation (OGSWC) is the agency responsible for the provision of water to the people of Ogun State. In its efforts to monitor the volume of water supplied to residential and commercial buildings, as well as manage demand and improve cost recovery, it introduced conventional and pre-paid metering to Abeokuta in 2013 and 2015 respectively. As a result of the differences in the operations of the metering systems and their users, this study compares the consumption of respective users in different areas of Abeokuta, as well as the cost recovery from the use of the meters. The study utilized available water consumption data and revenue generated per household per month of pre-paid and conventional meter users for a period of three years, 2015 - 2018. The total area covered by public water supply in Abeokuta was grouped into seven and data compilation was done using Microsoft Excel; one-way ANOVA was used to determine if there were statistical differences between the data groups. Results indicate that the average annual consumption of pre-paid water users was 36,384 m<sup>3</sup>, while that of conventional water users was 230,496 m<sup>3</sup>. Areas around Elega and Mawuko had the highest average monthly water consumption of 19,069 m<sup>3</sup> and 88,929 m<sup>3</sup> respectively for pre-paid and conventional meter users, while areas around Ita-Oshin and Adigbe had the least of 336 m<sup>3</sup> and 1,335 m<sup>3</sup> respectively, indicating an inverse relationship between water consumed/supplied with the distance from the source of supply. A total sum of N13,491,200 was generated from the pre-paid meter users while a total sum of N5,325,470 was the balance yet to be paid by conventional meter users for the period of three years the research work covered. ANOVA results showed that there were significant differences between the data groups. It is, therefore, concluded that the pre-paid water meter type can sustain the agency better than the conventional meter type, since the total water consumed by a user can easily be accounted for by a pre-paid meter unlike the conventional water meter that does not ensure a full recovery of the incurred water bill.*

**KEY WORDS:** *Conventional water meter, Water Consumption, Cost Recovery, Ogun State, Pre-paid water meter.*

## INTRODUCTION

Ogun State Water Corporation is the agency responsible for the provision of water to the people of Ogun State. In its efforts to monitor the volume of water supplied to residential and commercial buildings, as well as manage demand and improve cost recovery, it introduced conventional and pre-paid metering to Abeokuta in 2013 and 2015 respectively. In conventional water metering, water consumption is measured and periodic readings are used for billing purposes (Puleoet al., 2014). In contrast, pre-paid water metering is based on purchase first and consumption later, thereby requiring consumers to pay before water consumption (Kumwenda, 2006; Schnitzler, 2012). As a result of the differences in the operations of the metering systems and their users, this study compares the consumption of respective users in different areas of Abeokuta, as well as the cost recovery from the use of the meters. Specifically, the study identified which of the water users and areas in Abeokuta used more water and why, and consequently,

identified which of the metering system that can better sustain OGWC.

## The Study Area

The study area included all the areas that OGSWC supplied water to in Abeokuta, the capital of Ogun State, southwestern Nigeria. The location map of Abeokuta is presented in Figure 1. Abeokuta covers four Local Government Areas, viz Abeokuta North, Abeokuta South, Odeda and Obafemi Owode. The city is within the rain forest zone and it is about 100 km from Lagos seaport. The terrain of Abeokuta is characterized mainly by basement complex rocks including granites, migmatites, schists and gneisses. It lies between longitudes  $3^{\circ} 17' E$  and  $3^{\circ} 26' E$  and between latitudes  $7^{\circ} 10' N$  and  $7^{\circ} 15' N$ . Abeokuta covers a geographical land area of 879 km<sup>2</sup> and had a projected human population of about 646,138 with an annual growth rate of 3.03% according to 2006 census (Federal Republic of Nigeria Official Gazette, 2009). The city is drained by Ogun River and many tributaries, some of which include Sokori, Gbangba and Arakanga Rivers.

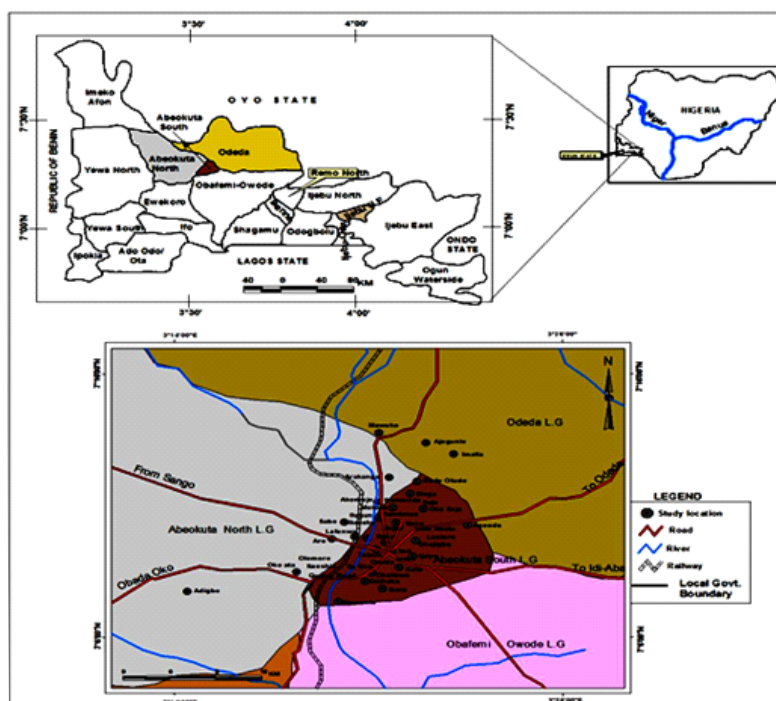


Figure 1: Location map of the study area

## Materials and Method

The total area supplied by OGSWC in Abeokuta was grouped into seven major sections (Adatan, Elegu, Ago-Ika, Mawuko, Ibara, Adigbe and Ita-Oshin). The grouping was done on the basis of the proximity of the areas to each other. The volume of water consumed and revenue generated per household per month for both pre-paid and conventional meters users were obtained from OGSWC for a period of three years (November, 2015 – October, 2018). The conventional water meter was introduced in December, 2013. However, for easy comparison, the data collection was limited to 3 years, starting from November, 2015 because pre-paid water meter was introduced in July, 2015 and there was no adequate data on water use until November, 2015. The historical data on monthly volume of water consumed by conventional meter users within the study area for a period of twenty-six (26) months (November 2015 – December 2017) was used, in addition to the data on volume of water consumed by individual households for a period of ten months (January – October 2018) collected through field investigation. The investigation was done by accompanying OGSWC field officers assigned to all conventional water meter users within Abeokuta for meter readings. Available historical information on revenue generation for the two meters from October 2015 to November 2018 was obtained from OGSWC in order to compare the revenue generation for both meter types and know the type of meter that could better sustain the Corporation. The purposes of water consumption were categorized into four major types, domestic, commercial, institution and industrial, in order to estimate which of the water consumption purposes was mostly supplied by the corporation. Domestic users were those in residential homes and quarters, while commercial users were those involved in

sachet water and table water production, block making factory, canteen and carwash. Institutional users were those in schools, mosques, churches, hospitals, filling stations, cooperative houses, construction companies, barracks and shops, while hotels, guest houses, poultries, eateries and farms were categorized as industrial users.

Data compilation and analysis were done using Microsoft excel. One-way Anova, with Statistical Package for Social Sciences, was used to know if there was a statistical difference between the data groups.

## Results and Discussion

### Annual Water Consumption

The respective annual volumes of water consumed by pre-paid and conventional water meter users for different purposes in respective years are presented in Table 1. For pre-paid meter users, the respective volumes of water consumed from November, 2015 to October, 2016 (First year), November, 2016 to October, 2017 (Second year) and November, 2017 to October, 2018 (Third year) were 16,366, 40,275 and 43,039 m<sup>3</sup> respectively, with an annual average volume of 36,384 m<sup>3</sup>. On the other hand, conventional meter users consumed 275,194, 249,072 and 167,222 m<sup>3</sup> in the first, second and third year respectively, with an annual average of 230,496 m<sup>3</sup>. Results indicated that water consumed by pre-paid meter users increased annually, while that by conventional meter users decreased, with the second to the third years being more drastic than the first to the second years. However, more water was consumed by the conventional than pre-paid meter users. The difference in consumption may be due to the fact that pre-paid meter users paid for the water they consumed before consumption, and therefore, minimized the way they used water. In contrast, conventional meter users were allowed to consume the water first before making

payments, thereby allowing them to use the water freely before billing.

The highest average annual volume of water consumed by pre-paid meter users (26,458 m<sup>3</sup>), as well as by conventional meter users (106,236 m<sup>3</sup>) were for commercial activities (Table 1).

### **Monthly variation of water consumed across the major areas in Abeokuta**

The average monthly volume of water consumed by pre-paid and conventional meter users over the years in the study area, are shown in Tables 2 and 3 respectively. For pre-paid meter users, results indicated that water was mostly consumed at Ibara in January (437 m<sup>3</sup>), whereas Elega, Adatan, Ago-Ika and Mawuko had their highest average monthly consumptions in February (3,226, 285, 724 and 692 m<sup>3</sup>, respectively), while Ita-Oshin and Adigbe had theirs in August at 74 m<sup>3</sup> and 303 m<sup>3</sup> respectively (Figure 3). Adigbe had its least consumption in March (50 m<sup>3</sup>), Itaoshin in February (5 m<sup>3</sup>), Ago-Ika, Ibara, Elega and Adatan in June (104, 110, 990 and 100 m<sup>3</sup> respectively), while Mawuko had its least consumption in September at 320 m<sup>3</sup>. In general, pre-paid meter users in Elega area had the highest consumption (19,069 m<sup>3</sup>) while those in Ita-oshin area had the least (336 m<sup>3</sup>). That may be because Elega was the closest to the water source, while Ita-Oshin was the farthest. The highest consumption of water was in February at 5,326 m<sup>3</sup>, while the least consumption was recorded in June at 1,765 m<sup>3</sup>. ANOVA result indicated that there was a significant difference ( $F = 3.313, p < 0.05$ ) between the average volume of water consumed by pre-paid meter users in different parts of Abeokuta supplied by OGSWC (Table 4). Conventional meter users in Elega, Adatan, Ago-Ika and Mawuko had the highest average monthly consumptions in January at 5,774,

2,557, 1,377 and 9,608 m<sup>3</sup> respectively. In Ita-Oshin, it was in March at 3,789 m<sup>3</sup>, while in Adigbe and Ibara, it was in May and November at 205 m<sup>3</sup> and 5,348 m<sup>3</sup> respectively. However, Adigbe had its least consumption in March (54 m<sup>3</sup>), Itaoshin and Ago-Ika in August (613 and 339 m<sup>3</sup> respectively), while Ibara, Elega, Adatan and Mawuko areas had their least consumptions in October at 2,240, 2,764, 1,038 and 4,895 m<sup>3</sup> respectively (Figure 4). In general, Mawuko had the highest consumption (88,929 m<sup>3</sup>) whereas Adigbe had the least at 1,335 m<sup>3</sup>, indicating an inverse relationship between water consumed/supplied with the distance from the source of supply. Results also indicated that the highest consumption of water by conventional meter users was in January (25,812 m<sup>3</sup>), while the least was in October at 13,398 m<sup>3</sup> (Table 5). Similar to the results obtained for pre-paid meter users, ANOVA result indicated a significant difference ( $F = 3.160, p < 0.05$  between the average volume of water consumed by conventional meter users in different parts of Abeokuta supplied by OGSWC (Table 5).

### **Sustainability of Ogun State Water Corporation**

The operation of pre-paid water meters allowed water users to settle their bills before use. This method enabled a full recovery of income expected for all the water supplied by the OGSWC to its customers. The purchase trend of pre-paid meter water users indicated that, a total sum of N2,626,300 was paid for water use in the first year, which increased to N5,116,300.00 in the second year and to N5,748,600.00 in the third year. Table 6 presents a summary of the purchase trend of pre-paid meter water users. In contrast, conventional water meter users had a total sum of N3,650,050.00 left unsettled in the first year. It decreased to N640,155.00 in the second year, but increased to N1,035,265.00 in the third year. Recovering this huge sum of

unsettled bills might be difficult since the water users might decide to consider alternative water sources, even when disconnected from OGSWC

supply, and as such, create a financial challenge to the Corporation, which in turn might affect its operations.

Table 1: Annual Volume of Water consumed for both pre-paid and conventional meter water users (m<sup>3</sup>)

Year	Purpose	Ita-oshin		Ibara		Adigbe		Elega		Adatan		Ago-ika		Mawuko		Total	
		Pre-paid	Conventional	Pre-paid	Conventional	Pre-paid	Conventional	Pre-paid	Conventional	Pre-paid	Conventional	Pre-paid	Conventional	Pre-paid	Conventional	Pre-paid	Conventional
Year 1 Nov2015 - Oct,2016	Commercial	0	2253	1904	3585	0	0	7760.7	18818	665	5710	2555	11434	1778	84475	14661	126275
	Domestic	3	15407	301	24140	272	126	515	35165	525	18842	398	6060	51	16303	2065	116043
	Institution	14	2669	121	10306	0	0	19	1289	0	648	0	649	0	0	154	15561
	Industrial	0	2519	0	12755	0	0	0	1710	0	331	0	0	0	0	0	17315
	Total	17	22848	2326	50786	272	126	7779	56982	1190	25531	2953	18143	1829	100778	16366	275194
Year 2 Nov2016 - Oct,2017	Commercial	0	6042	2106	2027	250	0	15912	14597	702	5552	6393	10426	6990	76560	32352	115204
	Domestic	319	22299	900	24514	1548	484	2592	26554	1403	16490	578	5123	1159	16524	8498	111988
	Institution	69	1991	450	5184	0	1445	129	1811	147	120	0	479	1	0	796	11030
	Industrial	47	1086	0	7180	0	0	1155	2584	19	0	0	0	0	0	1221	10850
	Total	435	31418	3456	38905	1798	1929	17196	45546	2271	22162	6971	16028	8150	93084	40275	249072
Year 3 Nov2017 - Oct,2018	Commercial	48	341	770	1174	101	0	22720	11411	764	3568	1225	243	6732	60491	32360	77228
	Domestic	482	7076	2208	23359	2516	1189	6366	23426	1495	12571	1257	370	1897	12433	16221	80424
	Institution	0	1068	339	1017	0	760	18	616	192	207	182	4	3	0	734	3672
	Industrial	24	650	0	3233	0	0	21	1564	46	451	0	0	0	0	90	5898
	Total	555	9135	3317	28783	2616	1949	22758	37017	2497	16797	2663	617	8632	72924	43039	167222
Average	Commercial	16	2879	1593	2262	117	0	15464	14942	710	4943	3391	7368	5167	73842	26458	106236
	Domestic	268	14927	1136	24004	1445	600	3158	28382	1141	15968	744	3851	1036	15087	8928	102818
	Institution	28	1909	303	5502	0	735	55	1239	113	325	61	377	1	0	561	10088
	Industrial	24	1418	0	7723	0	0	392	1953	22	261	0	0	0	0	437	11354
	Total	336	21134	3033	39491	1562	1335	19069	46515	1986	21497	4196	11596	6204	88929	36384	230496

Table 2: Average volume of water consumed by pre-paid water users in different distribution areas of Abeokuta

Distribution Area	Average monthly volume of water consumed ( m <sup>3</sup> )												
	January	February	March	April	May	June	July	August	September	October	November	December	Total
Ita-Oshin	17	5	10	14	14	8	13	74	53	72	26	31	336
Ibara	437	291	238	169	116	110	126	312	259	353	266	356	3033
Adigbe	112	103	50	85	70	61	131	303	201	188	134	125	1562
Elega	2747	3226	2128	1368	1210	990	1055	1279	1029	1047	1249	1742	19069
Adatan	272	285	173	127	127	100	135	185	117	117	157	190	1986
Ago-Ika	539	724	703	305	140	104	195	271	194	531	205	285	4196
Mawuko	611	692	595	587	617	392	463	513	320	383	478	553	6204
Total	4734	5326	3897	2654	2293	1765	2117	2938	2173	2692	2515	3282	36384

Table 3: Average volume of water consumed by conventional water users in different distribution areas of Abeokuta

Distribution Area	Average monthly volume of water consumed ( m <sup>3</sup> )												
	January	February	March	April	May	June	July	August	September	October	November	December	Total
Ita-Oshin	2508	1815	3789	1703	1449	1056	804	613	918	1588	2504	2387	21134
Ibara	3913	3440	4745	3091	2720	2802	2665	2338	2314	2240	5348	3877	39491
Adigbe	75	167	54	122	205	62	79	137	63	69	187	114	1335
Elega	5774	4062	4047	4066	4358	2844	3151	3056	3873	2764	4232	5210	46515
Adatan	2557	2080	1724	1801	1933	1533	1601	1401	1782	1038	1823	2224	21497
Ago-Ika	1377	1257	1042	1071	1174	718	736	339	607	803	1354	1118	11596
Mawuko	9608	8791	7674	8154	8547	7839	5729	5765	6225	4895	7452	8249	88929
Total	25812	21612	23077	20007	20385	16853	14766	13650	15782	13398	22899	23178	230496

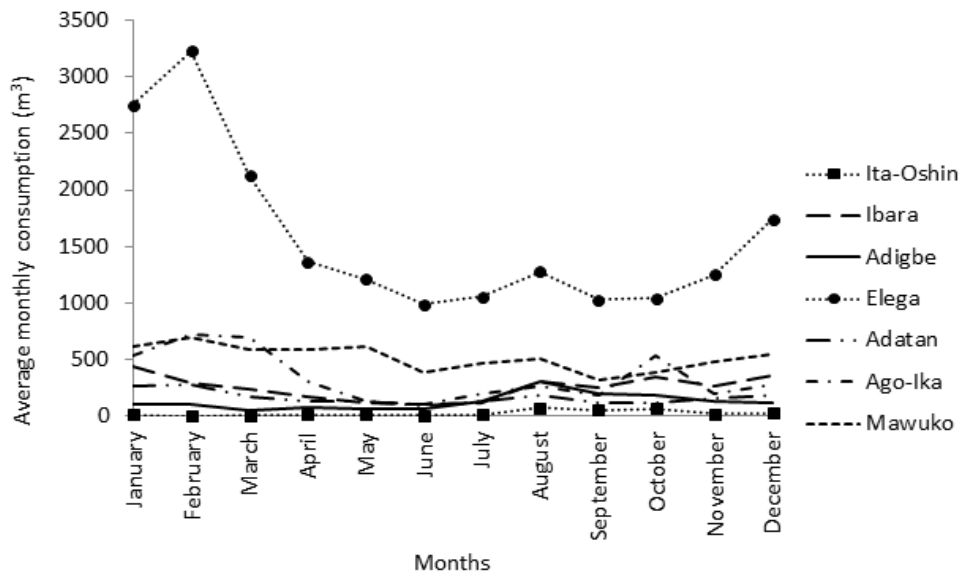


Figure 2: Trends of average monthly water consumption by pre-paid water users in different parts of Abeokuta

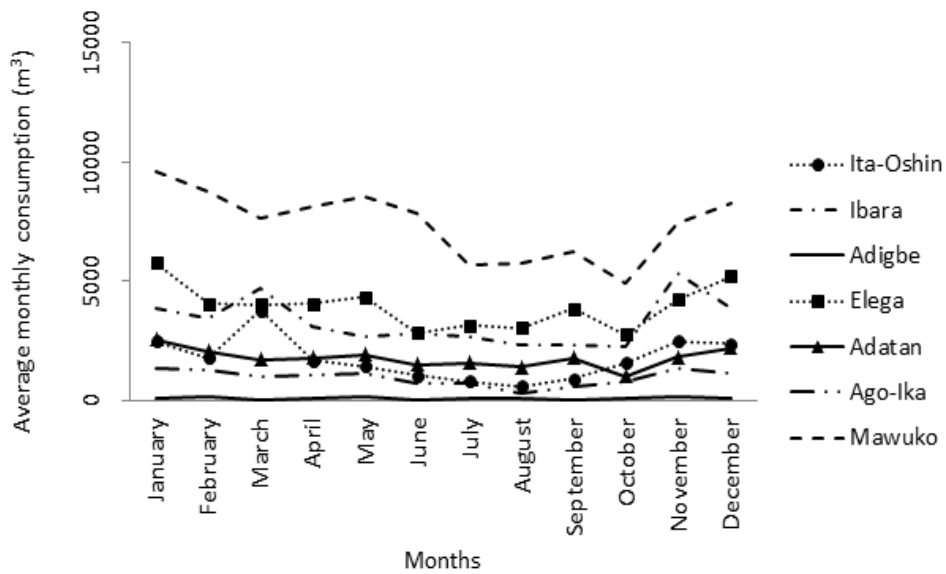


Figure 3: Trends of average monthly water consumption by conventional water users in different parts of Abeokuta

Table 4: ANOVA for water consumption by pre-paid meter users across the areas supplied by OGSWC in Abeokuta

Water Consumption	Sum of Squares	Df	Mean Square	F	Significant Value
Between Groups	125419646.95	6	20903274.49	3.313	0.006
Within Groups	485798863.00	77	6309076.14		
Total	611218509.95	83			

Table 5: ANOVA for water consumed by conventional meter users across the areas supplied by OGSWC in Abeokuta

Water Consumption	Sum of Squares	Df	Mean Square	F	Significant Value
Between Groups	3563376788	6	593896131	3.160	0.008
Within Groups	14470379074	77	187927001		
Total	18033755862	83			

Table 6: Purchase trend of pre-paid water meter users in Abeokuta

Period	Purchase (N)
Total for 3 years	13,491,200
Average Annual	4,497,067
Average Monthly	374,756

Table 7: Estimated bills for conventional water meter users in Abeokuta

Bill	Research year		
	First	Second	Third
Incurred (₦)	28,046,000	26,643,550	16,165,100
Settled (₦)	24,395,950	26,003,395	15,129,835
Balance (₦)	3,650,050	640,155	1,035,265

### Conclusion and Recommendations

A total volume of 791,168 m<sup>3</sup> of water (with 99,680 m<sup>3</sup> by pre-paid meter users and 691,488 m<sup>3</sup> to conventional meter users) was consumed throughout the research period (3 years) in Abeokuta, with an average annual volume of 263,723 m<sup>3</sup>. The average annual total consumption by pre-paid and conventional meters users were 33,227 m<sup>3</sup> and 230,496 m<sup>3</sup>, with annual average of 97 m<sup>3</sup>/user and 317 m<sup>3</sup>/user respectively. The more water consumption by the conventional meter users may, however, be as a result of the advantage of use before pay they had over the pre-paid meter users. Other factors may include occurrence of leakages or burst in pipes, which were rarely reported for fixing and may eventually add up to water consumption. Pre-paid meter users in communities around Elega consumed more water than other areas supplied by OGSWC, which must have been as a result of their proximity to Arakanga old and new schemes where treatment of water was taking place (source of supply). On the other hand, users in Ita-Oshin consumed least water, which can be attributed to the far distance from the source of supply. Similarly, conventional meter users in Mawukowere closest to the source of water

supply and consumed more water than other areas. Users in Adigbe, however, were farthest from the source of water supply and consumed the least.

The highest water consumption for both pre-paid and conventional water meter users was for commercial purpose, while the least for pre-paid and conventional meter users were for industrial and institutional purposes.

From the results, it would appear that pre-paid water meter users were good water conservers in comparison to conventional water meter users. The pre-paid meter worked in such a way that if a person was not able to pay in advance for water, he or she would not have access to portable water supply. A pre-paid customer would not be careless to waste the water he had paid for and would therefore be judicious. In addition, he/she would not delay to report or fix leakages or burst pipes promptly, attributes not found in conventional water users. Furthermore, pre-paid meter users tended to conserve water through the use of alternative sources, such as rainwater harvesting and groundwater, for other house chores such as laundry, toilet flushing, carwash, watering of flowers, washing of kitchen utensils and bathing.



Conventional water metering, though enabled the generation of high income due to high water consumption by users, had a tendency of being unreliable in terms of accountability since water users could always use water without paying, thereby eventually resulting to a low revenue collection with respect to the volume of water supplied. Low revenue collection could result into poor management, ineffective maintenance and high non-revenue water. It can, therefore, be concluded that pre-paid water meter type can better sustain the Corporation than conventional meter type, since the total water consumed by a user could be easily accounted for by a pre-paid meter unlike the conventional water meter that could not ensure full recovery of the incurred water bill.

It is, therefore, recommended that OGSWC should consider increasing pre-paid water meter distribution, or even focus on pre-paid water meter alone. This would help to eliminate the problem of unsettled bills by water users, which

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in turn would increase revenue collection, promote water conservation and thereby increase the access to potable water. Consequent on the recommendation, pre-paid water vending points, where customers can purchase water during the weekends and after official working hours, should be located at all the area offices of OGSWC and not limited to the headquarters. Secondly, to enhance convenience and customer satisfaction, purchasing of water units should be extended to cover mobile phone and internet platforms. Lastly, it is advised that OGSWC field officers should be keeping a log book of all faults and technical problems that may occur with pre-paid water meters. This information can be shared with the pre-paid water meter suppliers in order to help curb the problems faced, improve the efficiency of the meter and its acceptability by customers.

## Acknowledgement

The authors wish to thank Ogun State Water Corporation for providing most of the data used.

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