

Contribution of Simplicity of Prepaid LUKU Meter Billing System on Property Tax Revenue Collection in Moshi Municipality, Tanzania



Grace Jordan Mwanjala, Nyanjige Mayala, Ladis Komba

Abstract: *The simplicity of electronic systems, including prepaid billing systems, has been said to simplify life for clients and service providers. The Tanzania Revenue Authority (TRA) collects property tax through the 'Lipa Umeme Kadili Utumiavyo' (LUKU) prepaid electricity billing system. This study sought to establish the influence of the system's simplicity on property revenue collection by TRA in Moshi Municipality. A concurrent research design with a mixed research approach was employed. The study was informed by the ability to pay principal theory. The study population was 14,364 premises installed with LUKU meters in the study area. A sample size of 192, determined by Fisher (1991), was used. A questionnaire was used to collect primary. Secondary data was obtained using a documentary review guide to gather data from audited reports of TRA from the financial year 2018/2019 to 2022/2023 (5 years). Content validity was used to ensure the instrument's validity, while reliability was ensured through test-retest measures. A statistical package for social science (SPSS) was used as an aid for data analysis where the regression models were run. The study anticipated an observable relationship between the simplicity of the LUKU system and property tax collection (independent and dependent variables), respectively. The study established that the simplicity of the LUKU system contributes to property tax collection in the study area at p-value < 0.05. The study concluded that the simplicity of use of the LUKU prepaid billing system has increased property tax revenue collection for TRA. It is recommended that TANESCO convert more meters into prepaid, as it will enhance property tax revenue collection capabilities and, at the same time, reduce costs associated with collection.*

Keywords: Property Tax, Simplicity, Revenue Collection, Electricity Prepayment System, Prepaid Meters

I. INTRODUCTION

A prepayment system is an upfront payment paid by a consumer for using an item or service before consumption [9; 10].

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Over time, using prepayment meters for electricity, water, and piped gas has been suggested as a creative approach to making these utilities more affordable, decreasing costs, and enhancing revenue collection. This system necessitates consumer prepayment for the supply of products or services before consumption [1; 2] Consumers acquire credit and, after that, utilize the service till the credit is depleted. When making investment decisions, organizations must evaluate the financial costs of developing new machinery and the additional assets typically involved in any growth or activity. An overall expansion in the size of operations generally indicates a requirement for higher quantities of cash [20].

Both developed Western and developing countries have adopted prepaid billing technology. Prepaid metering has been a longstanding practice in the United Kingdom, allowing customers to pay in advance for their utilities [10]. The development of prepayment technology in Africa originated in South Africa during the late 1980s. Its primary aim was to provide electricity to a significant number of low-income individuals who were spread out across several locations. The system's primary objective was to reduce the challenges caused by users' unpredictable wages and address the insufficient infrastructure development needed to transmit and receive credit slips [12].

Property tax is a reliable and consistent source of revenue that is considered both practical and progressive [18]. However, this particular type of tax has yet to be given the necessary focus to contribute effectively to income generation in developing nations. However, in industrialized countries, the situation is distinct as they have made deliberate endeavors to harness the potential of property tax to attain fiscal and non-fiscal benefits for their communities. Thus, evaluating the efficacy of the current tax legislation and regulatory mechanisms in maximizing the contribution of property tax to the national revenue pool is important [18].

The Local Government Finance Act of 1982 and the Urban Authorities (Rating) Act of 1983 regulate the collection of property tax in Tanzania [5]. The government has introduced property tax payments by purchasing power tokens to assure convenience and compliance [7]. Starting on 1st July 2021, the Tanzania Revenue Authority (TRA) began collecting property tax using the LUKU system. This change was made possible by an amendment to the Local Government Authority Tax Act, Chapter 289, which was approved during the Parliamentary Budget sitting for 2021. As a result of this amendment, property rates in Tanzania were modified. The fee for conventional construction within the compound has been increased to 12,000 shillings from the previous levy of 10,000 shillings.



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The cost for a single-floor building has been increased to 60,000 from 50,000 shillings. Nevertheless, in district and town councils, apartment buildings are subject to a flat fee of Sh 60,000, regardless of the number of floors [6][7].

Despite the advantages, there are worries worldwide over deploying property tax collection using prepaid systems such as LUKU. The problems related to property taxes typically stem from the evaluation of properties' assessed value (2; 17). Inaccurate or opaque valuation processes can result in conflicts and objections from property owners. There have also been concerns over the efficient collection of property taxes, which necessitates the excellent management of data and the integration of information from several sources. Outdated or incorrect property records, such as the installation of numerous meters in one building resulting in multiple charges instead of a single charge for the appropriate property, might hinder the efficiency of the LUKU system.

The prepaid billing system is considered efficient and has few errors, as it relies on the constant base tariff price for power during periodic reviews. Customer billing operations are crucial for generating money in various private and public sector entities, including homes. Within public service delivery, billing serves as the primary driver of cash flow and the crucial source of information for clients utilizing these services. Implementing billing process reforms and enhancing collection systems have significantly increased revenue collection efficiency across various countries. Most information about the impact of billing on revenue collection efficiency, specifically property tax collection, is derived from the energy sector [15]. Thus, this paper aims to assess the contribution of the LUKU system on property tax collection in Moshi Municipality, Tanzania.

A. Statement of the Problem

According to some experts, billing methods based on usage are more likely to be paid by individual customers. One possible approach regarding the provision of power would be to universally implement electricity metering or spot-billing [24]. Additional strategies to enhance revenue collection efficiency include implementing computerized customer databases and billing systems. According to [24], minimizing human involvement in billing operations, including taxation, is essential for preventing fraud and errors.

Instead of invoicing after utilizing a service, prepayment is more advantageous. By streamlining the payment process and providing households with a clear overview of their expenses, this system guarantees fair compensation for services while aiding in financial planning for facility-related costs, i.e., electricity and property tax [14]. emphasize the significance of offering services to economically disadvantaged customers, who could greatly benefit from the availability of installment payment options and potential debt forgiveness. The study's primary objective revolves around the simplicity of the prepaid system for users, particularly in the context of property tax collection. The current study assessed the simplicity of the LUKU prepaid meter system's influence on property tax collection in Moshi Municipality, Tanzania.

B. Hypotheses

H0 – The simplicity of the prepaid meter system does not significantly contribute to property tax revenue collection in Moshi Municipality

H1 - Simplicity of the prepaid meter system significantly contributes to property tax revenue collection in Moshi Municipality

II. THEORETICAL LITERATURE REVIEW

A. The Ability to Pay Principal Theory (Appt)

Adam Smith initially formulated the concept of ability-to-pay in his renowned work, *The Wealth of Nations* (1776). Smith contended that taxes should be determined by the capacity of each citizen to contribute to public expenditure. He believed this approach would guarantee that all individuals contribute their just portion of taxes. It would also be more just and impartial compared to alternative taxing techniques, such as the poll tax, which imposed an equal tax burden on all individuals irrespective of their income. According to this view, individuals having more significant financial resources, such as higher earnings or more valued assets, should bear a more substantial tax burden. An underlying premise is that the tax system ought to be progressive. Consequently, individuals with more earnings should be subject to a more significant proportion of their income being allocated to taxes. This concept is founded on the notion that those with higher financial resources possess a greater capacity to endure the weight of taxation. APPT is based on the ideals of impartiality and equality. It presupposes that an equitable tax system should allocate the tax responsibility based on individuals' capacities to contribute. But, individuals with higher financial means should be willing to contribute more significantly.

APPT has been regarded as a fairer approach to taxing than other systems, such as the poll tax. Furthermore, it is considered a more effective method of taxes, as it does not hinder economic activity. Moreover, it is regarded as a more equitable method of taxation, as it guarantees that each individual contributes their proportionate amount (23; 13). However, APPT has faced criticism about its challenging measurement of individuals' ability to pay. Furthermore, the system may be perceived as unjust for individuals with high incomes but modest expenses. Moreover, it can be perceived as a deterrent to exerting effort and attaining higher earnings [19;17;21].

Nevertheless, the APPT continues to be a significant foundation of taxation in multiple countries globally. It is regarded as a means to guarantee that all individuals contribute proportionally to their tax obligations and that the tax system is characterized by fairness and effectiveness [3; 23; 27]. The significance of the theory in the present study lies in its applicability to the assessment of the fairness, equity, and social consequences of property tax systems. Although the ability-to-pay theory may not be directly utilized in the computation of property taxes, it remains relevant in the broader context.

Additionally, it is worth noting that the system is more user-friendly than the postpaid system. When evaluating the influence of property taxes on various population groups, researchers should consider these secondary consequences related to tax collection.

III. EMPIRICAL LITERATURE REVIEW

Several studies worldwide have investigated the simplicity of prepaid electricity bill systems relating to revenue tax collection [26]. surveyed the impact of tariff increases and power supply shortages on urban households in Ethiopia. Through correlation analysis, they found that implementing new prepayment meters reduces corruption within the electricity sector, making electricity revenue collection more accessible. The improved accuracy of the system eliminates the need for consumers to rely solely on the trustworthiness of the electricity companies. As clients are now required to pay their bills in advance, the practice of accepting bribes to connect customers who have yet to pay their bills is rapidly diminishing. Additional research revealed that the new electricity meters can instantly disconnect consumers when they exhaust their power credit. The study determined that the prepayment meter is superior to the postpaid system in terms of accuracy and consumer control. Electricity customers can regulate their energy usage. If individuals notice an increase in their energy usage, they can determine which aspects to eliminate to decrease their energy consumption.

Similarly, the tax authority can effortlessly collect property tax automatically when the client purchases electricity directly. The present study, however, is more concerned with quantifying expenses in more than one aspect. Instead, it centers on examining the influence of the prepaid LUKU system on property tax collection.

[8] conducted a systematic literature review on the use of information and communication technology to ease and address property tax collection difficulties in Tanzania by simplifying the process of bill payments. Their findings indicate that implementing a prepaid system for electricity use leads to both positive and negative financial outcomes for both the energy provider and consumers. Implementing prepayment systems can reduce expenses related to metering, billing, and disconnection and reconnection for energy providers. By requiring pre-payment for electricity consumption, the system significantly improves revenue collection accuracy and reduces the need for working capital.

Prepayment systems enhance consumers' comprehension of electricity consumption, increasing control over energy usage and improving budget management. Nevertheless, the study needed to ascertain the precise degree to which the prepaid meter system is simple for clients to use and ultimately contributes to property tax collection, which is the primary topic of the current study.

According to [12][13], their study on prepaid metering, electricity use, and utility revenue found that convenience in terms of the system's simplicity is an essential factor in the perceived usefulness of prepaid metering. The study used descriptive and inferential statistics to analyze the data and concluded that convenience positively impacts consumers' willingness to use prepaid metering. The study verified that the level of convenience has a substantial role in the customers' acceptance and utilization of prepaid metering in Hong Kong. Additional findings indicated that consumers consider easiness crucial in embracing prepaid metering services. Hence, the convenience consumers perceive substantially impacts their actual behavior towards prepayment metering. The perceived convenience indicates that the system is straightforward and facilitates the tax collection authority in efficiently collecting property tax.

The effects of socioeconomic, housing, and metering aspects were analyzed in a study conducted by [1] on electricity efficiency in households with postpaid-prepaid meters in Lagos, Nigeria. The study involved a survey of local electricity customers and revealed that the simple usage of prepaid meters improved welfare. Furthermore, the study highlights additional benefits of the prepaid system, such as minimizing outstanding debts in accounts receivables, lowering operational and financial expenses for the service provider, and improving resource allocation for the user. In his study [1], determined that implementing the system would decrease administrative collection expenses, improve accuracy, reduce tariffs, increase profit margins, and enhance property tax collection. The previous study examined the energy efficiency of employing a prepaid metering system. The current study aimed to evaluate the influence of the LUKU prepaid metering system on property tax collection in Moshi Municipality, Tanzania.

A study by [25] examined the relationship between off-the-grid prepaid power and the political economy of waste in Palestine. The study utilized a concurrent research design with a mixed approach. The findings revealed that in the past, customers with a standard credit meter had payment options other than paying bills in arrears. Additional findings showed that while the prepayments made by clients through these choices help to even out their payments, they are not directly correlated with electricity use. These payment solutions did not directly correlate electricity usage decisions and the subsequent prepayment frequency and amount. Prepayment meters altered the dynamic between customers and electricity sellers, as customers took on more accountability for overseeing their electricity usage, taking advantage of the simple system. Implementing the meters suggested by the system has a trickle-down effect on other government entities, such as property tax collection. The current study was conducted in Tanzania to assess the influence of the simplicity of the prepaid LUKU system on the collection of property taxes.

IV. METHODOLOGY

This study used a concurrent research design with a mixed approach. This design allowed the collection of both quantitative and qualitative data simultaneously. The mixed approach provides a more profound and broader understanding of the research problem by combining the strengths of both quantitative and qualitative methods. The design can also be used to triangulate data, which means that it can compare and contrast the findings from different approaches to increase the validity of their conclusions.

The target population for the study was 14,364 households with prepaid meter connections in Moshi Municipality [7]. The sample size for the study was 192 respondents, as Fisher & Hall [4;6] determined. Data was collected using a questionnaire and documentary review guides for secondary data from TRA. Content validity ensured that all study aspects were covered well in the literature. Reliability was ensured through the Cronbach alpha coefficient, where a 0.782 coefficient was obtained.

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Regression analysis predicted a significant correlation between these variables, i.e., simplicity and property tax collection. A statistical package for social science (SPSS) was used to aid analysis. This package was preferred because it can cover a variety of statistical and graphical data analysis systematically.

A. Analytical Model

$$Y = \beta_0 + \beta X + \epsilon \quad (2)$$

Where

Y=property Tax Collection

X= LUKU system simplicity agreement by clients

β_0 = Y-intercept

β =coefficient

ϵ = Error term of the model

The study included descriptive and inferential analysis to examine the association between the variables. The statistical procedures employed in this study consisted of the correlation coefficient (r) and the Pearson correlation coefficient. The significance tests employed included regression analysis intended to provide the coefficient of determination (R^2) and analysis of variance (ANOVA) with the corresponding t-tests, f-tests, z-tests, and p-values. The variables, sample size, and research strategy influenced the selection of these methodologies. The inferential statistical approaches were conducted with a confidence level of 95% ($\alpha = 0.05$). Data was analyzed using the Statistical Package for the Social Sciences Software (SPSS). The results were presented using quantitative data in the form of tables.

V. FINDINGS AND DISCUSSION

A. Descriptive Statistics Prepaid Meters Installation

Statistics on the number of prepaid meters under the billing system and the property tax collection were calculated annually between 2019 and 2023, as obtained from the TRA Report [7]. The data is presented in Table 1.

Table 1: Summary of Statistics

Year	Number of Registered LUKU Meters (Mean)	Std. Dev (Meters)	Property Tax Collected	Std. Dev (Revenue)
2018/2019	7,007	410.23	7,340,711	574,310.45
2019/2020	8,308	634.16	11,764,000	511,302.20
2020/2021	11,902	731.14	285,648,000	987,567.67
2021/2022	13,006	754.09	312,144,000	1,234,616.90
2022/2023	14,364	870.03	347,160,000	1,457,870.28

Source: Field Data, (2024)

From the results as depicted by the study period, there was an average rise in the number of prepaid meters under the prepaid LUKU billing system for the five years, from 7,007 in 2019 to 14,364 in 2023, accompanied by a rise in average yearly property tax revenue collection. In addition, the high standard deviation indicates high variations in meter installations across the years in the study area. Also, with more installations in the number of prepaid meters under the LUKU billing system, the revenue collection that was directly charged every month kept increasing. Further, the findings depicted a change in mean value from 7,007 in 2019 to 11,003 in 2020 with standard deviations, indicating variation in property tax collection revenue for the study period [16].

B. Correlation Analysis

Pearson's correlation coefficient was used to measure the relationship between the ease of use of the LUKU system and the efficiency of property tax collection. The Pearson product-moment correlation coefficient, sometimes known as the Pearson correlation coefficient, is a numerical measure that quantifies the degree of linear relationship between two variables. It is represented by the symbol "r". The Pearson correlation coefficient, denoted as r, ranges from +1 to -1. A value of 0 signifies the absence of any correlation between the two variables. A number beyond 0 indicates a positive correlation, meaning that when one variable's value increases, so does the value of the other variable. If a value is less than 0, it signifies a negative correlation, meaning that as one variable increases, the other variable declines. A Pearson's Correlation Coefficient analysis was conducted, and the resulting data is provided in Table 2.

To test the significance of descriptive statistics, the hypothesis tested here was that:

H2 - A positive relationship exists between the number of LUKU meters and revenue collection.

Table 2: Pearson's Correlation Coefficient Matrix

		Number of LUKU Meters Billing System
Property tax Revenue	Pearson Correlation	0.512**
	Sig. (Two-tailed)	.000
	N	196

Source: Field data, (2024)

** . Correlation is significant at the 0.01 level (2-tailed)

The findings from Table 2 indicate a statistically significant positive correlation ($r = .512^{**}$, P-value < 0.01) between the number of LUKU Meters under the prepaid billing system and the collection of property tax income. Therefore, increasing the number of LUKU Meters installed under the prepaid billing system enhances the collection of property tax revenue. Based on this parallel, the hypothesis, which states that there is a positive relationship between the number of LUKU meters and revenue collection, is supported, whereas the alternative hypothesis is rejected. The findings indicate a strong and statistically significant positive correlation ($r = .512^{**}$, P-value < 0.01) between the quantity of LUKU meters used in a prepaid billing system and the amount of money collected as property tax. Consequently, implementing additional prepaid LUKU meters inside the prepaid billing system will increase the collection of property tax income. This finding aligns with a survey by [11] in Ekiti state, Nigeria. The survey found that prepaid meters positively impact welfare, reducing arrears in accounts receivables, operational costs, and financial costs for service providers. Additionally, prepaid meters enhance the allocation of resources. As a result, consumers can manage their finances and gain complete visibility into their purchases as the system makes simple signs.

C. Regression Analysis

Furthermore, a regression analysis was performed to examine the relationship between the respondents' 'YES' (1) or 'NO' (0) responses on the extent to which the simplicity of the LUKU billing system contributes to property tax collection in the research area. A regression analysis



was performed, applying the natural logarithm to the numbers to minimize mistakes in the study. The summary of the model's results is displayed in Table 3.

Table 3: Model Summary

Model	R	R Square	Adjusted R-Square	Std. Error of the Estimate
1	.216 ^x	.655	.172	.196
x- Predictors: (Constant), YES response to simplicity of LUKU billing system				

Source: Research Findings, (2024)

In this instance, the coefficient of determination (which represents the proportion of the dependent variable's variation that can be accounted for by changes in the independent variables) is $R^2 = 0.655$. It means that 65.5 percent of the variation in property tax revenue collection can be attributed to the perception that the LUKU system is easy to use, as indicated by the number of YES responses.

Data results indicate that a change in the ease of use of the LUKU prepaid meters system leads to a 0.172-unit increase in property tax revenue collection. To effectively improve revenue collection from property tax, installing additional LUKU meters and ensuring their operation is straightforward and understandable to consumers is necessary. It aligns with the findings of [22] who observed that the prepaid metering system is an innovative billing method in the energy industry that incorporates an advanced electronic customer accounts management system. It combines metering equipment with smartcard technology, for example. It offers convenience and significant cost reductions while introducing more payment choices for clients, such as tax payments to tax authorities. Implementing a paperless revenue collection system can save operational expenses. Additionally, it can replace any electromechanical meters now available on the market.

D. Analysis of Variance (ANOVA)

Table 4: Analysis of Variance Results

Model	Sum of Squares	Df	Mean Squares	F	Sig.
Regression	0.043	1	0.043	9.87	0.000 ^x
Residual	0.202	43	0.004		
Total	0.245	49			

Source: Research Findings, (2024); x- Dependent variable (property tax revenue collection)

The F statistic has a significance value of 0.000 in this case, showing that the predictor variables (namely, the YES response about the simplicity of the LUKU billing system for property tax) account for a large amount of the variation in revenue collection. These findings confirm the statistical significance of the model as a whole [28] [29] [30].

Table 5: ANOVA Coefficients

Model	Unstandardized Coefficients		Standardized Coefficients Beta	T	Sig.
	B	Std. Error			
Constant YES response to LUKU billing system	4.41	0.077	0.021	59.11	.000
	0.07	0.012		2.336	.000

Source: Research Findings, (2024)

The regression equation can be expressed based on the findings of the regression coefficients as $Y = 4.41 + .07X$

The regression model demonstrates the degree to which property taxpayers using LUKU meters under a prepaid

billing system accurately influence property tax revenue collection as the regressed responses of YES and NO values to demonstrate the simplicity of the LUKU prepaid system came significantly. The results suggest that a decrease in the ease of use of the LUKU system, as applied to prepaid property tax, leads to a reduction of 0.07 units in revenue collection, as shown in Table 5. To enhance property tax revenue, TANESCO should expand the installation of prepaid meters. As users have expressed satisfaction with the simplicity of these meters and their integration with property tax payments, the TRA will be able to collect more property tax revenue. The results align with those of [12], who discovered that revenue divergence is reduced by eliminating errors and collecting taxes directly from the electricity billing system, leading to a more efficient collection of property charges. Thus, the null hypothesis is rejected, and the alternative hypothesis is accepted.

VI. CONCLUSIONS AND RECOMMENDATIONS

A. Conclusions

The regression analysis demonstrated that the ease of employing LUKU meters in the prepaid billing system was a strong predictor of property tax revenue collection. The study also found that the predictor variables, namely simplicity, account for a large amount of the difference in property tax revenue collection. Additionally, the overall model is statistically significant. The study confirms that using the LUKU prepaid billing system substantially influences the collection of property tax revenue by TRA in the study area. The study findings provide sufficient evidence that implementing direct property tax charges using LUKU prepaid meters improves revenue collection efficiency in Moshi Municipality.

B. Recommendations

Based on the conclusions made from the study findings, it is recommended that TANESCO consider converting a more significant number of meters into the LUKU prepaid meter system, as it seems simple for taxpayers to pay their property tax to the tax authority. The LUKU system thus simplifies the budgeting process for the users, bearing in mind that whenever they purchase the electricity tokens, they will also have to pay the property tax automatically. On the other hand, the conversion will improve the collection of property tax revenue and minimize the costs of collection by the TRA.

DECLARATION STATEMENT

After aggregating input from all authors, I must verify the accuracy of the following information as the article's author.

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- **Funding Support:** This article has not been sponsored or funded by any organization or agency. The independence of this research is a crucial factor in affirming its impartiality, as it has been conducted without any external sway.
- **Ethical Approval and Consent to Participate:** The data provided in this article is exempt from the requirement for ethical approval or participant consent.



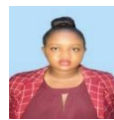
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- **Data Access Statement and Material Availability:** The adequate resources of this article are publicly accessible.
- **Authors Contributions:** The authorship of this article is contributed equally to all participating individuals.

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