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THE ROLE OF ENERGY RESOURCES TO PRODUCTION OUTPUT IN CEMENT ORGANIZATIONS IN TANZANIA: EVIDENCE FROM SELECTED ENERGY RESOURCES

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Abstract

In a country, energy is an important resource to be considered for development of a Nation. The total country energy consumed determines the level of development of a Nation. Being the case, countries and organization should be provided with empirical evidence on how energy resources affect production output. However, in this area, little has been researched to explain the effect of energy resources on production output. Therefore, this paper aimed at determining the role of energy resource to production output in cement organizations. The study was conducted in Tanzania and used time series data for ten (10) years, from year 2005 to year 2014. In order to assess the effect of energy resource on production output, the study used multiple linear regression model to analyze the data. From the findings of the study, it was revealed that energy resources have positive and significant effect on production output in cement organizations. Being the case, cement organizations should consider energy resource as a key and an important resource in production of cement.

Keywords: Energy Resource; Production Output; Cement Organization

1. INTRODUCTION

In any nation, industrial development is a key driver of a national economy. However, for industrial development, there are several factors which need to be taken into consideration by both organizations and a Nation at large. Among the factors, energy resource is a factor to consider. This is due to the fact that energy resources are driving resources for organizations to deliver their offerings. If there are inadequate energy resources, organizations will produce little hence low economic development of a Nation. In that ground, energy consumption level determines the industrial development level of a Nation (Aguegboh & Mudueme, 2013). Being a case, organizations need to consider the availability, accessibility and efficiency use of energy for improved organizational outputs.

In any organization, delivering of organizational offerings involve transforming inputs into their desired outputs (goods and/service). In transforming inputs, there are transforming resources (labor and facilities) which act on the transformed resources (material, information and customer). Facilities are the ones of transforming resources which require driving energy to function. Therefore, organizations need appropriate source of energy that runs their facilities for desired outputs (Slack *et al.*, 2007; Heizer & Render, 2011).

Energy is an important resource for organizations to operate their facilities. However, energy availability and costs are very crucial for growth and suitability of organizations. This follows

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the rule of thumb that in today's business environment organizations face tough competitions in the market, therefore lack of energy or using expensive sources of energy it may take an organization out of the market. Being the case, organizations have been identifying and using low costing source of energy that leads to reduced operating costs for promising organizational profits (Isaksson, 2009; Rohdin & Thollander, 2006).

Despite the importance of energy resources in organizations, organizations lack clear information explaining the effect of energy on the organizational output. This is due to the reason that there are few studies in the area as majority of conducted studies focusing on energy consumption and country economic growth (Bernard & Oludare, 2016). Furthermore, the few conducted studies are not based in Tanzania (Rutatina Et Al. 2014). Following this shortage of studies in the area, the current study aimed at explaining the effect of energy on organizational production output. The study used a cement manufacturing organization as a case of study because they requires very large amount of energy in producing cement especially at the stage producing clinker by heating limestone to a temperature of 950°C (Jacott & Comunes, 2003). On top of that, cement companies use large percent of total energy in many countries (Osama, 2014). In explaining the effect, the study determined the effect of electricity, diesel (EME thermal energy), HFO thermal energy and coal thermal energy on organizational production output as they are the most used source of energy in cement manufacturing company in Tanzania.

2. Theoretical Literature Review

2.1. Production Output

Production output is the amount of goods or services delivered by a machine, factory or an individual in a given time horizon. Production output is an outcome of production process which take in a set of inputs (can be raw materials, information, or customers) and convert them (where facilities and human resources act on the inputs through different interrelated activities) to their desired production output (Slack *et al*., 2007; Heizer & Render, 2011).

2.2. Energy Resources

Energy is an ability to do a work. Energy is a resource which is used to run facilities in the production processes. There are various forms of energy; electric energy, thermal energy, chemical energy, kinetic energy, radiant energy, gravitational energy and others. The sources of energy are electricity, coal, biomass, hydropower, thermal and solar to mention few. The sources of energy can be classified into two groups; non-renewable and renewable energy. The examples of non-renewable energy sources are coal, natural gas and petroleum while the examples of renewable energy sources are biomass, hydropower, solar and wind. In this case, energy source is anything that can be used to generate energy. The availability and accessibility of the energy sources are very critical to an organization for increased production output (Benesch, 2012).

In Tanzania, the energy sector is largely dominated by biomass. Biomass accounts abouts 88% of a total 20.7 million tons of oil equivalent (MTOE) of the total primary energy supply in 2011. However, the fuel imports reached about 1.6 MTOE and represented 32% of total imports to the country. In 2011, energy consumption per capita was 0.48 tons of oil equivalent (TOE), one of

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the lowest rates in the world and only two-thirds of the average consumption in sub-Saharan African developing countries (AfDBG, 2015).

The residential sector accounts for most of the energy used, the vast majority of which consists of biofuels and agricultural waste; 80% of biomass used in the residential sector is for household cooking, with about half of annual charcoal consumption occurring in Dar es Salaam. Petroleum products comprised 8.1% of total final consumption, whilst electricity accounted for just 1.9% (AfDBG, 2015).

2.3. Energy Resource and Production Output

In cement manufacturing organizations, energy resources are required in large amount in delivering cement product. Statistics indicates that cement organizations consume large quantity of energy; for instance, the energy consumption is about 3% of the world primary consumption (IEA, 2010). In Tanzania, cement organizations use coal and diesel to generate thermal energy for clinker production. The electricity is the energy which is used as power to run facilities which are used in difference activities in producing cement output.

2.4. Production theory

Although there are various theories trying to explain how resources are effectively utilized for production output, the most prominent and appropriate theory in this study is the production theory. The theory explains about the way resources and materials are used to produce desired Outputs (Cobb & Douglaus, 2000). The theory points out the resources to be labour, capital, land and materials (Mishra & Mehta, 2009). The theory is in-line with the input – process – output model. The theory is adopted in this study because it is in line with the focus of the study; in explaining the effect of energy on organizational output. Mathematically, the production theory can be presented in form of equation as follows: -

$$O = f(C; L; X) \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots.1$$

$Where\ O = Output$

$C = Capital$

$X = Intermediate\ inputs$

In order to explain the effect of energy, the multiple linear regression model was used in this study. The energy resources used in this study are electricity, thermal energy, diesel and coal thermal. Mathematically, the relationship is presented as follows:

$$O = f(E; T; D; C) + Constant$$

$Where\ O = Productuin\ output$

$E = Electricity\ used$

$T = Thermal\ energy\ used$

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$D = Diesel\ used$

$C = Coal\ thermal\ used$

$Constant = Error\ term$

3. Empirical Literature Review

Empirically, there are studies which have been done in the focus of study, for instance, the study by Ray and Reddy (2012) is among the studies in the area. The study aimed at analysing the energy uses in cement manufacturing organizations in India. The study used panel data and stochastic frontier production function. The study found that there is significant decrease in energy in organization due to various production technique used. The other studies are presented as follows: -

A study by Bernard and Oludare (2016) had an objective of investigating the contribution of energy consumption on output of industrial sector in Nigeria. The study used time series data for 23 years, in which the error correlation mechanism was used to analyze the data. The study found that there was positive effect of energy on the industrial output.

A study by Erbaykal (2008) in Turkey assessed the relationship between energy consumption and economic growth. The study used a time series data which was analyzed by using the Auto Regressive Distributed Lag (ARDL) Bounds test. The study found that there is relationship between energy consumption and economic growth.

Shaari, Hussein and Ismail conducted a study in Malaysia in 2012, the study was focused on assessing the relationship between energy consumption and economic growth. The study used time series data in which cointegration and Granger causality test was used to study the relationship between variables. The study found that there is unidirectional causality running from GDP to electricity consumption, Gas to GDP.

In their study of Akomolafe, Danladi And Babalola (2012), studied the relationship between consumption of electricity and Nigerian economic growth. The study used the Granger causality model and time series data from 1971 to 2010. The study revealed that there was two-way causality running from foreign direct investment to Gross Domestic Product, a unidirectional effect of foreign direct investment to Gross Domestic Product, a direct effect of electricity consumed on foreign direct investment and lastly the effect of energy consumed on direct investment from foreign countries.

A study by Baghedo and Atima in 2013 in Nigeria, focused on examining the impact of petroleum on economic growth. The study used time series data for years between years of 1981 and 2011. The results showed that pentroleum have significant effect on Gross Domestic Product (GDP).

A study by Qazi, Ahmed and Mudassar (2012) in Pakistan aimed at investigating the relationship between energy consumed and output. The study used Vector Auto Regressive Method and time

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series data from 1972 to 2010. The results show that there is long run equilibrium relationship between energy consumed and industrial output.

From the presented empirical literature review, it was deduced that the majority of presented studies aimed at examining the relationship between energy consumed and economic growth of a country. The studies used the Granger Causality, Vector Auto Regressive Method, the Auto Regressive Distributed Lag (ARDL) Bounds test, error correlation mechanism and stochastic frontier production function. Not only that but also the studies were conducted in other countries rather than Tanzania. Therefore, this study was conducted in Tanzania in order to find out if the same holds in Tanzania and focused at determining the effect of energy used on organization output; whereby multiple linear regression model was used to test the relationships between energy sources and organizational output.

4. Methodology

4.1. Research Philosophy

The study used a positivist philosophy, in which gaining of understanding in the area of study prior to data collection was very important. The understanding was achieved through conduction of literature review in the area of Study (Ndunguru, 2007; Saunders *et al*, 2005).

4.2. Research Design

The selection of a research design was based on the nature of the study problem to be assessed; therefore, the study used longitudinal survey. The design was selected because the nature of problem required time series data. Being the case, the design enables the collection of time series data for a period of 10 years, from 2005 to 2014 since their record were available. The data was collected from the organization of interest, which was the unit of analysis for this matter (Ndunguru, 2007; Saunders *et al*, 2005).

4.3. Operationalization of study variables

In order to collect the required data, it was very important to indicate the type of data to be collected. Therefore, operationalization of the study variables was of paramount important. The table below presents operationalization of the study variables.

Table 3.1: Variables measurement

Variable	Description of the Variable	Measurement of the variable
Energy Resource	Diesel (EME thermal energy) is a mixture of hydrocarbons with boiling points ranges between 150 to 180°C.	Number of litters
	Electricity is a form of energy resulting from the existence of charged particles	Kwh
	HFO thermal energy is a heavy fuel oil, a residue from crude oil refining process.	Number of tones
	Coal thermal energy is a fossil fuels created million years ago from layers of animal and plant matter	Number of tones
Production Output	Cement produced as per type of inputs in a production line	Number of tones

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4.4. Research Ethics

In this study ethical matters were observed, whereby free consent of an organization to participate in the study was adhered. Thereafter, the collected data from organizations was used only for the purpose of this study; explaining the effect of energy to organizational output. In this study, the collected data were analyzed and reported in a such a way that they won't jeopardize the image of organizations participated in the study (Ndunguru, 2007; Saunders et al, 2005).

4.5. Data Collection Method

In collecting data, the documentary review method was used. The method was used because in order to obtain data used by an organization for many years, it was necessary to extract the data from organizational reports. In this case, reports on energy used in an organization and organizational output were accessed and extracted accordingly (Ndunguru, 2007; Saunders *et al*, 2005).

4.6. Data analysis

In analyzing data, the multiple linear regression model was used. The model was used because the study aimed to assess the relationship between dependent and independent variable and the variables of interest were measured by using ratio measurement scale. In analyzing the data, only the energy inputs were considered affecting the output of the organization while other inputs to the input-process-output model were kept constant. In the data analysis process, preliminary data analysis was done to check whether data meets the condition of using multiple linear regression analyses before inferential data analysis was done (Saunders et al, 2005).

5. Results and Findings

In this study, preliminary and inferential analyses were done accordingly. The preliminary analysis was done to check whether collected data have quality or not and to check whether the collected data meets assumptions of multiple linear regression model before the inferential analysis is done. The results and findings of analyses are presented as follows: -

5.1.1 Outliers' Tests

The data range was checked in this study by outliers' test. The test was conducted to detect data which are out of range. The identification of these data was necessary to avoid wrong conclusion from the collected data. In this test, both univariate and multi-variate outliers test was done. The results are hereby presented in Table 4.1 and Table 4.2 respectively.

Table 4.1 Univariate outliers' test- Z-scores

	ZPro	ZEl	ZEME	ZHFO	ZCoal
1	-1.29714	-1.27568	-1.82995	-1.10532	-2.61019
2	-1.20199	-1.10315	-0.10141	-1.15790	-0.60717
3	-0.89270	-0.75188	-0.75672	-1.16407	0.00553
4	-0.57863	-0.67866	-0.28958	-1.16605	0.26011
5	-0.51157	-0.64963	0.43298	0.75020	0.21978
6	0.46248	0.28291	2.12278	1.16009	0.36728
7	0.72178	0.60279	-0.15599	0.60734	0.24787

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8	1.35509	1.26172	0.51428	0.76992	0.70561
9	0.86856	1.13586	0.03180	0.65289	0.78405
10	1.07410	1.17571	0.03180	0.65289	0.62713

Where Zpro = Standard Z Score - Production output

ZEI = Standard Z score – Electrical Energy

ZEME = Standard Z Score – EME energy

ZHFO = Standard Z Score – HFO energy

ZCoal = Standard Z Score – Coal energy

Based on the results in Table 4.1, it was reveal that, after converting all variables to z – score, all Z- score ranged between -3 and +3. This indicates that, there is no univariate outlier in all variables of the study. Thus, there was no univariate outlier problem in the collected Data (Kline, 2005).

On the other hand, the multivariate outliers were assessed based on the objective of the study. In this case, the Mahalonobis distance results were used to test the presence of multi-variate outliers due to relationships of study variables. The results for this test are presented in Table 4.2.

Table 4.2: Multivariate test - Mahalonobis distance values: Relationship between energy resources and production output

p values
7.60407
2.62486
2.43401
2.96716
7.11411
6.66744
1.18813
1.97454
1.70518
1.72050

From the results presented in Table 4.2, it was revealed that, all p-value were greater than 0.0001. This implies that there was no problem of multivariate outlier among the relationships of study variables of interest (Kline, 2005).

5.1.2 Normality

Furthermore, in preliminary analysis, the normality test was conducted to check how data of the study were distributed. The test was conducted by assessing the skewness and Kurtosis parameters. The results for the test are presented in Table 4.3.

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Table 4.3: Normality test parameters

Variables	N	Minimum	Maximum	Mean	Std. Deviation	Skewness		Kurtosis	
	Statistic	Statistic	Statistic	Statistic	Statistic	Statistic	Std. Error	Statistic	Std. Error
Production	10	581308	1043776	807489.50	174369.239	-.014	.687	-1.868	1.334
El energy	10	5136697	7409465	6279331.60	895709.159	.126	.687	-1.920	1.334
EME energy	10	823398	1399453	1090088.00	145735.846	.443	.687	2.636	1.334
HFO-Thermal energy	10	1887	1399453	702460.70	600807.779	-.395	.687	-2.167	1.334
Coal thermal energy	10	463	79738	61425.90	23355.720	-2.338	.687	5.998	1.334

Form the Table 4.3, the results indicate that all skewness indices ranged between -3 and +3, indices are within the range. This indicates that, the data` of the study were univariate normally distributed. On the other hand, kurtosis indices were less than 10.0; it also indicates that, data of the study are univariate normally distributed as it is suggested by Kline (2005). Therefore, the subsequent analyses were carried out since the assumption of normality is not violated (Tabachnick & Fidell 2001).

5.1.3 Linearity Assumption Test

The linearity of variables was checked by assessing the linear relationship between dependent and independent variables. The results for the test are presented in Table 4.4.

Table 4.4: Linearity test of dependent variable against independent variables

SN	Relation between	R^2 linear
1	Production output and electrical energy	0.978
2	Production output and EME energy (Diesel used)	0.278
3	Production output and HFO-thermal energy	0.684
4	Production output and coal thermal energy	0.523

From Table 4.4, it was revealed that dependent variable and independent variables were linearly related, keeping other factors constant. This finding is evidenced by the results that the effect of Electricity on Production is about 98%; the effect of diesel used on production is about 28%; the effect of thermal energy on production is 68%; and that of coal thermal on production is 52%.

5.2. Collinearity Test

Before performing inferential analysis, the multicollinearity analysis of variables was done to determine if there are variables that measured the same concept. The results of multicollinearity test are presented in Table 4.5.

Table 4.5: Collinearity test

	Prod	El	EME	HFO	Coal
Prod	0.000				
El	0.12	0.000			
EME	0.33	0.34	0.000		
HFO	0.08	0.09	0.86	0.000	
Coal	0.12	0.16	0.73	0.73	0.000

From the results presented in Table 4.5, it was revealed that the variables of the study have no problem of multicollinearity as the variables of the study are not measuring the same thing since

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correlations between variables is not 1 or close to 1 (Kline, 2011). This is evidenced by the results that the values of tolerance are in between 1 and 0; very few are less than 0.16. Therefore, in inferential analysis, multiple linear regression analysis was run among the variables of the study.

5.3 The effect of Energy resources on Production Output

After conducting preliminary analyses, inferential analysis was done. The aim of the study was to determine the effect of energy resources on production output in cement manufacturing industries. The energy resources in this study include EME energy (diesel used), Coal thermal energy, HFO thermal energy and electrical energy. The relationship between production output and energy resources was analyzed through multiple linear regression analysis and results were presented in Model summary and ANOVA results.

Before presenting the model which depicts the relationship between production output and energy resources, the effect of diesel, coal thermal, HFO thermal and electrical energies and their significance were analyzed as presented in Table 4.6.

Table 4.6: ANOVA results

Model	Df	F	Sig.
Regression	4	92.515	0.000b
Residual	5		
Total	9		

Source: research data (2015)

The results in Table 4.6 reveals that the overall multiple linear regression model of the study objective, which aimed at determining the effect of energy resources on production output, was good fit for the data since the independent variables statistically significantly predicted the dependent variable $F(4,95) = 92.51$, $p < 0.0005$. Thereafter the model summary which presents the quality of prediction of dependent variables was analyzed and results are presented in Table 4.7, as follows.

Table 4.7: Model Summary

Model	R	R Square	Adjusted R Square
1	0.993a	0.987	0.976

Source: Research Data (2015)

From the results presented in Table 4.7, it was revealed that the quality of prediction on dependents variable is excellent (R=0.993). This imply that 98.7% of production output in cement Manufacturing industries is explained by EME energy (diesel used), thermal energy, HFO thermal energy and electrical energy; keeping other factors constant while only 1.3% of the production output is explained by other factors of production which are not considered in the study. Since the overall multiple linear regression model is good and 98.7% of dependent variable is explained by the independent variables, then it was necessary to test how much each energy resource affected the dependent variable. The results of this test are presented in Table 4.8.

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Table 4.8: Effect of energy on production output

Model	Unstandardized Coefficients	Standardized Coefficients	T	Sig.
	B	Beta		
(Constant)	-389.705		-2.108	.089
El energy	.377	.909	8.014	.000
EME energy	.270	.259	.598	.003
HFO-Thermal energy	.225	.285	.720	.012
Coal thermal energy	.244	.219	.203	.027

Source: Research Data (2015)

The results from Table 4.8 depict that electric energy has positive significant effect on production output ($\beta \neq 0; p < 0.05$), EME energy has positive significant effect on production output ($\beta \neq 0; p < 0.05$), HFO energy has positive significant effect on production output ($\beta \neq 0; p < 0.05$) and coal thermal energy has positive significant effect on production output ($\beta \neq 0; p < 0.05$). These findings indicate that energy resources play significant role in improving the production output in cement manufacturing organizations. The study findings are in line with that of Bernard and Oludare (2016) in Nigeria and that of by Qazi, Ahmed and Mudassar (2012) in Pakistani.

6. Conclusion and Recommendation

6.1. Conclusion

The study aimed at determining the effects of energy resources on production output in cement manufacturing organization in Tanzania. From the study results, it was revealed that energy resources have positive and significant effect on the cement production output. Therefore, from these findings, it is evident that the energy resources have effects on the production output in cement manufacturing organizations. Being the case, cement manufacturing organizations should consider the energy resources as very important factor for their production output as they have significant effect in production output.

6.2. Recommendation

Based on the study findings, energy resources have significant effect on production output. This is evidenced by significant effects of diesel, coal thermal, HFO thermal and electrical energies on cement production. Therefore, this study recommend that cement manufacturing organizations should consider diesel, coal thermal, HFO thermal and electrical energies as important source of production. For future researches, this study recommends that studies should be done in the area while include other resources such as human and financial resources since the current study did not include them.

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