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The Effects of Electricity Transmission Lines on Community Livelihoods in Ghana

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Abstract
Purpose: This paper aims to establish the effects of electricity transmission lines on the livelihoods of communities in Ghana.
Method/ Approach: The paper adopts the stakeholder theory framework with quantitative research techniques to explained and established the effect of electricity transmission lines on community livelihoods.
Findings: The findings revealed that, electricity transmission projects have a substantial effect on communities such as access to farmlands. It also emerged that communities perceived such projects as a threat to their health and livelihood.
Originality: Contextually and geographically, paper is the first of its kind and has not been published anywhere.
Limitations: The limitation of the paper lies in its methodological approach where a qualitative research technique could have unearthern the perceptions variables of community dwellers
Recommendation: It is recommended that an effective and broader community education and stakeholder must be done prior to the implementation any electricity transmission line projects. The use of other data collection and sampling techniques to enable the transferability and generalization of the findings is recommended.
Conclusion: The study concluded that electricity transmission projects do provide benefits for the communities within the catchment areas, despite the negative perceptions held by residence of such communities.
Keywords: Communities, Electricity, Ghana, Livelihoods, Transmission.
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1. Introduction

Electricity transmission is the large-scale movement of electrical energy from a power production facility through a transmission line to a high-voltage substation. It also refers to the method by which electricity is transferred from the point of production to that of consumption. It involves the mass transport of electrical energy from electricity generation stations to high voltage substations. When interlinked, transmission lines constitute transmission systems, usually known as the power grid. Electricity is transmitted at high voltage; therefore, the long-distance transmission reduces the quantity of energy lost (Smith, 2019). Overhead power lines usually carry power; however, sometimes underground lines are utilized. High tension transmission lines consist of copper or aluminum lines hung by towers (Smith, 2019; Tobiasson *et al.*, 2015). Electricity transmission lines form the highway through which electricity is transmitted from the point of production to the point of usage (Tobiasson *et al.*, 2015).

The public knowledge of energy grids mainly concerns technical components, such as pylons and lines, rather than organizations. The inadequate public understanding of the development and management of transmission lines increases public opposition to new grid projects and limits public participation and a more active role of communities in the development process. The high number of communities involved along the transmission line is another consideration. Although every stakeholder should have a say in a project, all opinions and concerns cannot be considered (Smith, 2019). Electricity transmission projects enhance electricity distribution system operating efficiency, increase access to electricity, and reduce greenhouse gas emissions (GRIDCo, 2015). The deployment of electricity transmission projects across communities, homes and communities assured better live. The electricity supply provides access to electrical gadgets such as computers, TVs, refrigerators, and radios that can positively impact human development (GRIDCo, 2015). Electricity transmission project enhances the quality and reliability of energy supply. Electricity transmission offers a more comprehensive range of entertainment for households and gives access to essential information and employment. A stable electricity supply will help reduce enterprises not linked to the grid and now use costly stand-alone diesel engines or batteries as the primary energy source.

Table 1. Benefits of Electricity Transmission lines

s/n	Benefits	Source
1	Enhance electricity distribution system operating efficiency,	Agbesi and Okai (2016), GRIDCo (2015), Hensengerth (2018)
2	Boost population access to electricity	GRIDCo (2015)
3	Assist countries move towards a low-carbon economy by reducing greenhouse gas emissions	GRIDCo (2015), Hensengerth (2018)
4	Homes are assured of a better standard of living	GRIDCo (2015)
5	Electricity makes it more flexible for women to carry out their domestic chores	Agbesi and Okai (2016), GRIDCo (2015), Hensengerth (2018)
6	Improve the adoption of mechanized farming	Houssou and Chapoto, (2015), GRIDCo (2015)
7	Help enhance the quality and reliability of the supply of energy	GRIDCo (2015), Hensengerth (2018)

Source: Authors' Construct, 2021

In terms of community livelihood, it is a means of living which includes the skills, assets, income and activities of individuals needed to ensure existence. Supporting and rehabilitating individuals from shock and stress (for example, natural catastrophes, economic or social turmoil) and improving future generations' well-being is sustainable without weakening the nature or resource basis (Bhandari, 2013; Boadi *et al.,* 2016). Livelihood is described as a series of actions that are fundamental to our daily lives. It may involve water securing, food, fodder, medication, clothing, shelter. The livelihood of an individual includes the ability to acquire the above necessities to meet fundamental needs. FAO (2008, p.17) categorizes livelihood into five thematic areas: financial capital, human capital, natural capital, social capital, and physical capital (Lax and Krug, 2013).

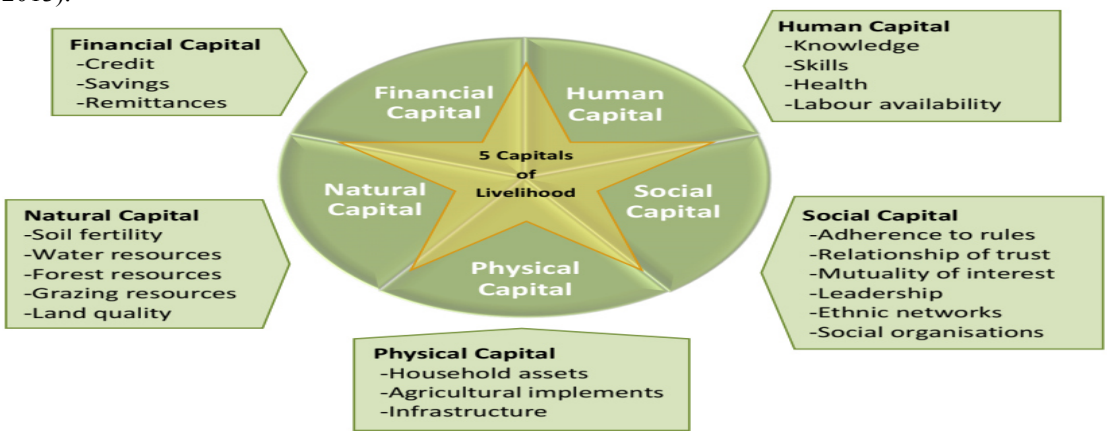

Figure 1. The five capitals: livelihood indicators. Source: Lax and Krug (2013).

Natural capital notably defines all livelihood activities for resource-dependent societies. It is a string value susceptible to disasters, especially for rural areas that represent a significant proportion of impoverished stakeholders. The design and implementation of any development goal are premised on the livelihood of the people and community. Conservation and development initiatives must therefore achieve ecological and social improvement without detracting from their main economic objectives. Protected places are crucial to biodiversity conservation (Pasanchay and Schott, 2021; Salleh, 2016). Biodiversity conservation is crucial and has direct interaction with community wealth and poverty. Community development initiatives deployed by government and local authorities must therefore seek to influence the conservation of livelihood and the protection of people.

Table 2. Community Livelihood

s/n	Variable name	Description	Source
1	Financial capital (Income)	Money earned and or liquid assets	Esinam, 2021; Sullivan, 2014; Pandey et al., 2017; Quandt, 2018.
2	Natural Capital	Water, land, biological resources	Pandey et al., 2017; Sullivan, 2014; Quandt, 2018.
3	Social Capital	Claims and rights	Lax and Krug, 2013; Quandt, 2018.
4	Physical Capital	Household assets, infrastructure and agriculture implements	Lax and Krug, 2013; Quandt, 2018.
5	Human Capital	Labour	Lax and Krug, 2013; Pandey et al., 2017; Quandt, 2018.

Source. Authors' Construct, 2021.

This paper adopts a stakeholder theoretical framework to explain the relationship and effects of electricity transmission lines on community livelihoods. Stakeholder theory discusses whether a company has more responsibility for the parties interested in the organization than shareholders and how these duties might be fulfilled (Bhasin, 2020). The theory mainly concerns financial output distribution. It is about how clients, suppliers, workers, financers, communities, and managers engage collectively to develop and produce trade value – shares, bondholders, banks etc.

The management of an organization will be responsible for managing relationships to give stakeholders much value and oversee the distribution of this value. Where the interests of stakeholders' conflict, management must look at the challenges to fulfil the demands of a broad group of interested parties to the extent that additional value is attached to each of these challenges (Parmar *et al*., 2010). A positive effect was established which dispelled the negative perceptions and misconceptions held regarding the health of those who live close to electricity distribution lines in Ghana.

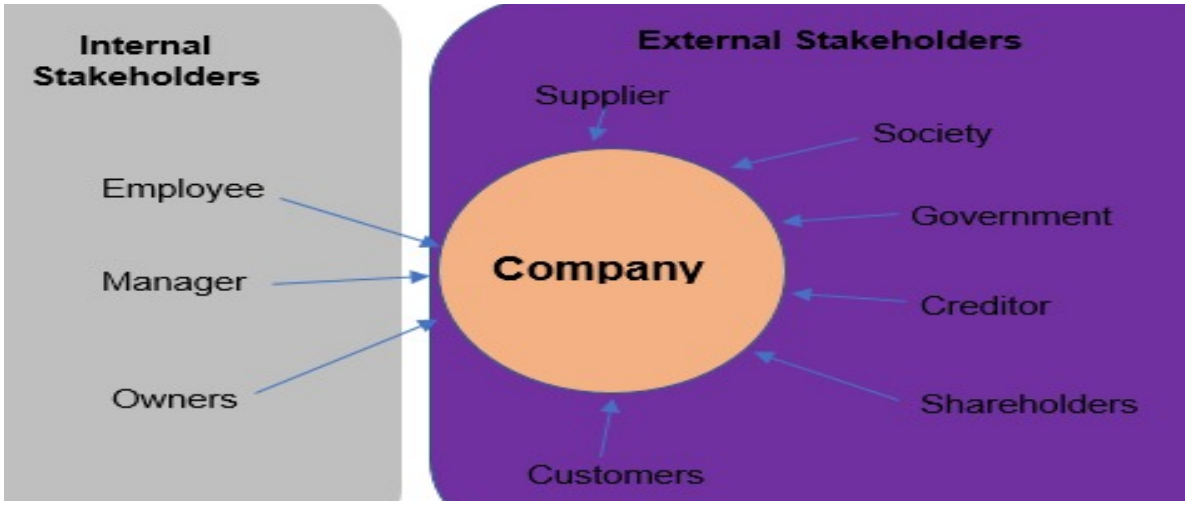

Figure 2. Stakeholders of a company. Source: Lumen (2021).

2.0 The Effects of Electricity Transmission Lines on Community Livelihoods

In a study conducted by Porsius *et al*. (2015), considering the community reporting of symptoms due to the introduction of high-powerlines, those individuals who lived within 300m expressed worrying symptoms reports compared to those far away from such power lines. The study found a negative relationship between high-voltage power lines (HVPLs) and the health perception of residents within a nearby community. Again, in Porsius *et al*. (2017), they examined the community perception on power lines and found that some 49% of respondents had weak responses to introduction of a new power line. Only 9% of the people in the identified community had considerable information on the erection and effect of new power lines in their community. Thus, 9% had decreased perceived health after the erection of the power lines. The study identified the heterogeneity in community perception of health implications on power line erection in their community.

Undoubtedly, the construction of any infrastructure has implications on the environment in which it is created. Understanding the effects, however, is a vital step in searching for and limiting solutions. Power lines usually damage the forests when crossing. To build power lines, many plants need to be cut down regardless of whether it is an overhead line or an underground cable. There are also benefits arising from the erection of electricity power lines within the community (Argyrou *et al*., 2018; Kumi, 2017).

This study conjectures that the construction of electricity transmission lines has an impact on the community. This perception is often mediated and or influenced by the benefits and adverse effects experienced by community members. However, there appears to be a lack of understanding and public appreciation of the construction of electricity transmission lines, especially in developing countries. Stakeholders' involvement and commitment to construction transmission lines have experienced mixed reactions, feelings, and experiences as recorded in extant literature (Cohen *et al*., 2016; GRIDCo, 2015; Knudsen *et al*., 2015).

It is admitted that there are adverse effects on livelihoods (GRIDCo, 2015). For instance, the soil and land use for electricity transmission lines have some adverse impacts on communities. These include farming communities that are bound to lose acres of land in the name of electricity transmission lines being a public goods. In addition, during the construction of electricity transmission lines, roadblocks increase traffic conditions (GRIDCo, 2015). Again, there is a restriction of vehicular movement in the areas where electricity transmission line projects are being constructed. It shows that the construction of electricity transmission line projects has a direct relationship to the local economy. Thus, construction of electricity transmission line projects delays or

shut down local economic activities and pose severe habitats health challenges (African Development Fund, 2014). The significant consequences during the service include visual interference, fire hazard, public safety associated with electrical installations; the danger of transformer and switchgear insulation oil leaks; the risk of gas leaks arising from modern gas switchgear.

Table 3. Effects of Electricity Transmission Lines

s/n	Effects of Electricity Transmission Lines	Source
1	Loss of farmlands for farming activities	GRIDCo (2015)
2	The creation of noise by electricity transmission lines within several communities	GRIDCo (2015)
3	An instance of roadblocks and their consequence of increased traffic conditions during the erection of electricity transmission lines	GRIDCo (2015)
4	Firms who are located around the construction sites have their operations distorted	GRIDCo (2015)
5	Socio-cultural effects	African Development Fund (2014).

Sources: Author Constructs, 2021

The erection of electricity transmission lines has an impact on society particularly concerning spatial planning Hedidor, *et al.,* 2016) and the livelihoods of community's folks. The trade-off between agriculture activities and electricity transmission lines has been established, especially among rural communities. The various communities have experienced adverse environmental impacts such as noise, roadblocks, and road diversion during electricity transmission lines. Stakeholders' participation is key to attaining public appreciation and acceptance of electricity transmission lines. There is evidence of long-term local disputes when electricity grids are being constructed. The instance of electromagnetic field (EMF) has been identified to impact the health of local people as electricity transmission lines. Other studies have also pointed to experience, emotional, and moral concerns as electricity transmission lines are being constructed in local communities. An economic impact that arises during the construction of electricity transmissions lines is the rise in property (housing) value and other essential services in the livelihood value chain (Bondinuba *et al.,* 2016). Dimensions of risk perception of ordinary folks to electricity transmission lines abound in extant literature. People's perception of distance in terms of one household to the electricity transmission lines have been identified as key to whether communities would accept the transmission lines or not.

In many countries, government agencies are responsible for approving proposals for transmission sites. Therefore, none of the individual entities balances all project elements to establish their public interest contributions (Komendantova *et al*., 2015; Olmos *et al*., 2018). There is a need for collaboration with community and policymakers to siting electricity transmission lines within rural and urban communities (Komendantova *et al*., 2015; Olmos *et al*., 2018). Stakeholder engagement and collaboration has been identified as key to promoting community participation, engagement, and acceptance of erecting electricity transmission lines within a locality. Government officials and companies who have the contract and capacity to erect such electricity transmission lines are responsible for involving the community at some point in the project's planning stage. Based on the above discussions, this study develops the conceptual framework as shown in Figure 1.

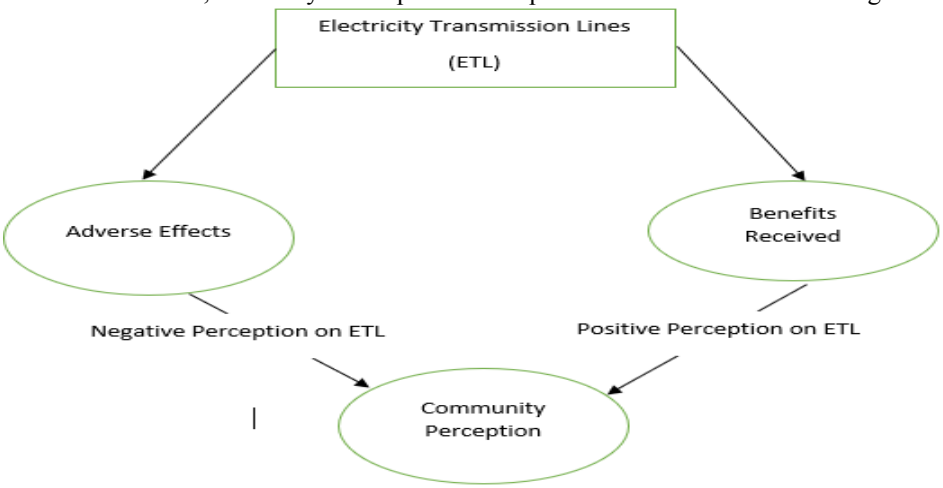

Figure 3. Conceptual model. Source: Author's Construct, (2021).

3.0 Research Approach

This study used quantitative research design specifically, the exploratory research approach to provide a vivid

comprehension of the phenomenon. Quantitative research is mostly used to establish the relationship between an independent variable and dependent variable in a study. It is frequently used within natural science to explain the causal relationship, to ease generalization, and forecast the future (Zikmund 2000). Quantitative research also involves large, randomized samples and the use of structured questionnaires mostly closed-ended questions with set responses (Burns, 2000). It has accuracy, control, and testing of hypotheses based on statistical analysis as its strengths (Zikmund, 2000). Weaknesses of the method denigrate human capacity to think, less account on human behaviour and motivation (Zikmund, 2000).

The study was limited to households and residents of communities living within 214km around the 330kV Volta-Aboadze line in Ghana. The total population of people living within communities described are 98,584 according to the Ghana Living Standard Survey 7 (2014). A purposive sampling, also known as judgmental, discriminating, or subjective sampling, is a type of non-probability sampling in which investigators choose people from the community to participate in their surveys based on their own opinion. This survey sampling strategy necessitates a previous understanding of the study's aim for researchers to appropriately choose and approach eligible individuals for surveys (Campbell *et al.,* 2020; Etikan *et al.,* 2016). Since the study is a quantitative study, a theoretical saturation approach shall be used to arrive at the final sample size. The choice of using the theoretical saturation technique is to help the researcher exhaust the issues under investigation and not necessarily provide an equal chance for all the people living within the community to participate in this study (Rowlands *et al.,* 2016; Nascimento *et al.,* 2018).

Data was collected from community households using a set of questionnaires guide that was developed based on the review prior studies. The general analysis of the data presented using the mean, standard deviations, correlation, normalcy, and multi-collinearity are in this section. The influence of electricity transmission projects (ETP) on households' benefit from electricity transmission projects (HBETP) and households' perception of electricity transmission projects is investigated using quantitative data (HPETP). Residents of the communities along the 330kV Volta-Aboadze line in Ghana provided information on the above. To derive parameter approximations for the definitiveness of the reliant data, the information for each resident was converted into a common logarithm. SPSS was used to present the information's results.

Table 5 presents the descriptive statistics of the variables with their mean, standard deviations, minimum, maximum and normality distribution. It is a common practice in quantitative analysis to transform variables to minimize heterogeneity in the data. Comparatively, electricity transmission projects (ETP) had the highest mean score of (M=7.944, SD=1.620) while households benefit from electricity transmission projects (HBETP) had the lowest mean score (M=0.285, SD=1.471). Households' perception on the effect of electricity transmission projects (HPETP) scored (M=1.849, SD=1.444). The results demonstrate that all the variables are favorably skewed in terms of skewness. Furthermore, all the factors were statistically significant, according to the Jacque-Bera and probability results.

Table 5 Descriptive Statistics

	ETP	**HPETP**	**HBETP**
Mean	7.944	0.285	1.849
Median	7.694	0.425	1.886
Maximum	11.425	3.740	10.076
Minimum	5.335	-8.928	-4.396
Std. Dev.	1.620	1.471	1.444
Skewness	0.531	-1.065	0.604
Kurtosis	2.202	6.075	7.852
Jarque-Bera	92.137	731.180	1306.505
Probability	0.000	0.000	0.000
Obs	20	20	20

Author's construct, 2021.

The Correlation Matrix

The findings show that the VIF for ETP, HBETP, and HPETP indicates that the normal variable fluctuation relates to the results. To monitor multicollinearity among the variables, the tolerance as well as the VIF for each variable were calculated and shown in Table 6. From the results, there is no multicollinearity among the explanatory variables because the T-values are less than 0.2 and the VIF values are less than 5.0. The variables under investigation are independent of one another and can thus be viewed as independent variables that are expected to be affected by power transmission projects (ETP). ETP appears to be linked to HBETP and HPETP, according to the correlation coefficients. It means there is a relationship between ETP and HBETP and HPETP.

Table 6 Correlation coefficients

Var	ETP	HPETP	HBETP	TOL	VIF
ETP	1				
HPETP	0.2185	1		0.927	1.079
HBETP	0.3822	0.1536	1	0.938	1.066

Author's construct, 2021

The Panel Cointegration

The results of the Cointegration test as presented in Table 7 represents five of the Pedroni tests of seven measurements suggested (Pedroni, 2004) as grounds for rejecting the null cointegration hypothesis. We regard Panel PP and Group PP measurements to be the same as the ADF Panel and ADF Group statistics as increasingly important and solid when creating these five statistics. It is clear from the cointegration results that the elements under research were cointegrated and so had a cointegration relationship. It is true that there is sufficient evidence to rule out null cointegration at a 1% significance level.

Table 7 Outcomes from (Pedroni, 2004) panel cointegration

Common AR coefficients (within-dimension)		
	Statistic	**Weighted value**
V-value	-1.573***	-2.092
RHO-value	0.132	-0.327
PP-value	-5.724***	-6.331***
ADF-value	-2.465***	-1.857***
Individual AR coefficient (between-dimension)		
RHO-value		0.821
PP-value		-7.963***
ADF-value		-0.752***
		Kao Cointegration
	t-statistic	Probability value
	1.214	0.002

***Denotes the rejection of the null theory at the 1% significance level. Author's construct, 2021.

The Panel Unit Root Results

Unit root testing is necessary to determine the variables' stationarity, which is critical for selecting a valid, trustworthy, and robust estimator for estimating the outcomes. In this paper, Dicker-Fuller (DF) unit root tests are used to analyze the nature of the merging factors via Pesaran (2007). The unit root results for the variables are shown in Table 8. In the face of heterogeneity, the findings of the data estimation on DF Pesaran remain strong. The estimation describes whether the indicators' null hypothesis may be accepted. This is strong evidence that the variables have a unit root.

Table 8 Panel Unit Root

Var.	**CADF**				
	Levels Const	Const trend	&	First difference Const & trend	
ETP	-1.919	-2.632**		-3.785***	-4.111***
HBETP	-2.592***	-2.716***		-5.093**	-5.167***
HPETP	-2.957***	-3.260***		-5.460***	-5.542***

Note: *** represents the rejection of the H0: at a 1% significance. Author's construct, 2021

The Quantile Results on the effect of Electricity Transmission Projects

By focusing on quantiles, the study established a direct link between ETP and HBETP and HPETP. It aids in gaining a thorough grasp of the influence on all quantile levels by estimating for each of the 25th, 50th, and 75th. In Table 9 it shows that ETP is explained by HBETP and HPETP at 25% on the 50th and 75th percentiles, with the marginal effect increasing from the lower to the highest quantile, which is explained by the OLS at a statistically significant level of 1%. As a result, a 1% increase in ETP causes HBETP and HPETP to increase by 0.093 and 0.083 percent respectively.

Table 9 The effect of ETP based on quantiles

Var	**Quantiles**			
Coef.	**OLS**	**25%**	**50%**	**75%**
	-1.418***	-0.293**	-0.315***	-0.331**
LnETP	(0.199)	(0.197)	(0.120)	(0.132)
	-0.358***	-0.047*	-0.045**	-0.044*
lnHBETP	(0.055)	(0.041)	(0.025)	(0.027)
	-0.700***	-0.037***	-0.047*	-0.055**
lnHPETP	(0.081)	(0.064)	(0.039)	(0.043)

Note: ***, **,* denotes the significance at 1%, 5%, 10% respectively. Author's construct, 2021

The Robustness Tests

Dealing with the endogeneity problem is a fundamental challenge in current quantitative analysis. Model uncertainty is a possible source of endogeneity in quantitative investigations. This is due to prejudices that have been overlooked. This work used the literature as well as several estimation approaches to determine the true regressors of ETP, HBETP, and HPETP to reduce model uncertainty and increase statistical correctness. We followed these procedures to solve the endogeneity problem. To begin, we used the literature and estimate methodologies to determine the genuine ETP regressors, which reduced model uncertainty and improved statistical accuracy. Second, because of their consistency, efficiency, and dependability, as well as their capacity to cope with endogeneity issues, quantile regression models are the most ideal methods for estimating quantitative data (Machado and Silva, 2019).

Table 10 Robustness Tests Results

Var	**ETP**	**HBETP**	**HPETP**
Hausman Test	2.63	0.97	4.22
P-Value	0.45	0.81	0.24

Author's construct, 2021

In terms of the study's robustness, the Hausman test was employed to assess the robustness of the variable's estimator for the analysis. The results of the Hausman test, as shown in Table 10, revealed that the Hausman test and p-value are not significant, indicating that the variables are more resilient for estimating models. As a result, the Hausman test indicates that the results are reliable.

4.0 Discussion of the Findings

The research revealed that electricity transmission developments along the 330kV Volta-Aboadze line in Ghana have a negative impact on the livelihoods of the populations. There are health concerns, as well as cost of lands that is the source of livelihood for these residents. Thus, the regression results show a significantly negative impact. In other words, the 330kV Volta-Aboadze line electrical transmission developments accounted for 58.8 percent of the impact. The findings support prior studies such as (GRIDCo, 2015; African Development Fund, 2014), which found that GRIDCo's energy transmission line projects have detrimental impacts on the communities they serve. The power transmission projects along the 330kV Volta-Aboadze line have a severe impact on livelihoods because they ruin people's farmlands. Even though affected farm owners are often reimbursed, the compensations are insufficient to match the benefits of the farmlands.

Again, the findings show that power transmission projects residents often have a negative perception concerning such projects within their communities. The findings means that communities along the 330kV Volta-Aboadze line are having negative perception of electricity transmission projects due to its effect on their health, farmland destruction, and radiation waves from power lines. Individuals are also vulnerable to electrical shock and stress through natural catastrophes, economic or social turmoil.

The communities along the 330kV Volta-Aboadze line benefit from energy transmission projects in the form of jobs, free electricity, and social facilities. Power transmission projects would also improve the efficiency of the electricity distribution system, increase population access to electricity, and help countries transition to a low-carbon economy by lowering greenhouse gas emissions. Policies and regulations concerning the erection of electricity transmission lines should aim at mitigating the dangers and threats it has on local communities, as well as ensuring that many indigents are employed on various projects.

Theoretically, the study ability to use stakeholder theory to explain the effect of power transmission projects on nearby communities and, by extension, local people's livelihoods contribute to the theoretical debate on stakeholder's livelihood. The findings also support the unfavorable perceptions of electricity transmission lines held by residence along the 330kV Volta-Aboadze line. In terms of managerial consequences, firms that want to invest in electricity transmission lines should first conduct thorough and effective education on the benefits of such projects to the people involved.

5.0 Conclusion

This paper examines the effect of electricity transmission projects on the livelihoods of communities by conducting a thorough evaluation of prior literature. The review of the literature serves as the foundation for a theoretical framework that provides guidance and insight on electric utilities and the communities affected by these projects and the benefits on their livelihood. Only the settlements along the 330kV Volta-Aboadze line were included in these studies. Future research should include more power lines fraternity so that the findings can be broadly generalized. Furthermore, the study used a quantitative technique for data collecting, other means of data collecting have not been examined. Future study should use a variety of sampling and data gathering approaches to guarantee that the findings are generalizable. In addition, the results in this study were interpreted using cross-sectional data, but longitudinal data will provide a more accurate picture.

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