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Key Barriers for Bioenergy Projects Implementation: A fresh insight from Ghana

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Abstract

This current study examines the barriers linked to the supply of bioenergy implementation projects in Ghana. This present study aims to provide an empirical analysis into the barriers to the supply of bioenergy implementation in Ghana and the stringent measures to put in place to mitigate such obstacles. This study utilizes both case study and survey approaches to achieve the research objective. We received 433 respondents from 433 high-ranking staff through questionnaires and expert interviews. Pearson correlation, as well as multiple regression analysis, were employed in this study. The empirical outcome of our research revealed that bioenergy implementation is affected by key barriers such as financial facilities, technical know-how, research data, proper legal framework, and political will. The study suggests that political decisions supporting acceptance and implementation, training and mental ability building, flexible funding mechanisms, and dissemination plans are needed if bioenergy production is to help societies. Also, legislative reform must form a legal framework to protect entrepreneurs and investors willing to invest in bioenergy projects. The contemporary study will help the government endeavor to include bioenergy shareholders in their policy development to integrate the industry's viewpoint into the process.

Keywords: Bioenergy; barriers; implementations; Pearson correlation analysis; technology policies; biomass.

1. Introduction

Bioenergy systems are considered a viable solution globally to mitigate global warming as they meet sustainable development's three components (Elum et al., 2017). This is against the backdrop of climate change due to frequent intense events like heat waves, deluges, shortage of rainfall, etc. (Harris et al., 2020). Both natural and anthropogenic activities cause weather changes by the Intercontinental Board for Climate Changes (IBCC). Examples of anthropogenic activities include using finite fossil fuels that release greenhouse gas emissions (a principal cause of global warming) (Harris et al., 2020). To mitigate global warming, IPCC has unveiled the Paris agreement to reduce greenhouse gas emissions through more detailed and practical deliverables of reducing global mean temperature below targeted thresholds (Harris et al., 2020). Within the context of climate change, conserving finite fossils fuels and gradually switching to renewable energy sources has become a vital mission for world leaders leading to the Paris agreement. Bioenergy systems, when appropriately planned, may deliver a fair number of ecological, social, and economic opportunities in achieving some of the detailed deliverables contained in the Paris agreement. This is important for the world especially developing continents such as Africa due to its enormous size and low economic development.

The bioenergy systems offer environmental and socioeconomic benefits for society from sustainable expansion. United Nations describes sustainability by way of "meeting our current desires devoid of conceding the capability of future age group in meeting their own needs" (Adekeye, 2019). Thus, the ability to uphold improvement at a particular level devoid of diminishing natural resources to maintain an ecological balance is essential for current and forthcoming generations. From agricultural development, reducing hunger, and promoting gender equality, the manufacture of recent bioenergy is viewed as a critical instrument for rural growth and poverty decline by the UN 2030 sustainable development goals (SDGs). Agriculture employs nearly more than 70% of the labor force in Africa, and agricultural farmers are the primary stakeholder for biomass resources (Lal et al., 2021).

Biomass resources in the state of finished agricultural trash or remains and woodchip have recognized marketplaces in the instantaneous manufacture of electrical energy and heat, serviceable as gasoline for transportation and a replacement of natural gas (Banks, 2015). The energy usage related to the harvesting and conveyance of biofuels cannot be ignored vis-à- vis the multiple benefits bioenergy plays, such as simultaneously reducing greenhouse gas emissions and promoting green energy (Leong et al., 2018). In the US, for example, special waste-to-energy plants (e.g., of bioenergy systems) uses hotness from the fire to create mist in producing power or to warm buildings. During 2018, around 14 billion kilowatt-hours of electrical energy from the combustion of 28.6 million tons of burnable municipal-solid-waste were generated from nearly 68 US power plants (Indrawan et al., 2020).

Similar success stories were recorded in European countries such as Germany, Belgium, and the Netherlands in the famous European Union plan bioenergy agriculture I and II. More and more stakeholders (e.g., farmers, users, policymakers) were interested in adopting bioenergy systems for climate protection (Geels & Johnson, 2018). In Australia, an attempt to enhance biomass utilization in electrical energy production began in 1997 to address climate change (Commonwealth of Australia 1997). The Australian administration's mandatory renewable bioenergy aim strategy and the renewable bioenergy certificate provide incentives to key commercial companies to engage in different bioenergy systems (Edwards et al., 2015).

Several methods are accessible to translate biomass into a beneficial energy source in China. Grounded on the bioenergy service merchandise, biomass utilization machinery is grouped into heat, electricity, gas, and gas lines. The significant lessons are printed as a portion of the project in all these countries, and the implementation of bioenergy systems is well articulated (Tareen et al., 2020). The best practices are presented as guidelines to promote best practices and basis for estimating the market potential of bioenergy systems worldwide. The guidelines document is helpful for policymakers in developing countries to introduce bioenergy technology. The documentation presents the basics of bioenergy development and defines the essential stages for developing bioenergy projects in these countries (How et al., 2019). Also, the documents describe the ecological, social, and economic gains in addition to giving a summary on legitimate outline circumstances for the various bioenergy systems to support for legislative improvement measures (Ramirez-Contreras & Faaij, 2018). Again, the document contained some guidelines, including a decision backing tool for agriculturalists and other concerned stakeholders such as consultants, industries, government and law enforcement officers, environmentalists, etc., to be trained through organized workshops. The overall success in these developed economies has improved the environmental performance of many industries when it comes to public opinion and corporate reputation (Epstein et al., 2018).

In Sub-Saharan Africa (SSA), two-thirds of bioenergy usage includes extremely ineffective burning of conventional biomass, which is frequently used inefficiently, mainly as fuel logs and charcoal meant for cooking and warming (Lebel et al., 2010; Boafo-Mensah et al., 2021). For instance, within West Africa, biomass remains a key economic, social, and environmental sector. Dependence on conventional biomass is exceptionally high and is estimated for about 75-90% of the primary energy provision and also up to 90% of the overall households' intakes. Within the 15 ECOWAS nations, traditional fuels contribute nearly 85% of the overall energy intake. Conventional fuels account for almost 83% of total energy usage in Nigeria. (Al Nuaimi et al., 2015). In contrast, hydrogen, carbons, and electricity share remains low at 15% and 6%. Many policy experts projected that SSA transition to bioenergy systems might be more straightforward than advanced economies based on over-reliance on traditional biomass for energy consumption. Nevertheless, the utilization of bioenergy resources is very much less proficient in the SSA region (Antwi et al., 2015).

Considering the little penetration of practical and present biomass usages, the question as to whether the hefty dependence regarding biomass-on-biomass energy within West Africa and Ghana, to be precise, would change soon. Several reasons may have been attributed to the little penetration of practical and recent biomass usages. Commercial returns needed to create the machinery attractive within the industry world in Africa may be a factor, or legal framework conditions in these countries are unfavorable (Kemausuor et al., 2015). These and other reasons are on the minds of researchers. This paper is curious to investigate the possible barriers to implementing bioenergy projects in SSA, focusing on Ghana as a case study. The current study's contributions are as follows; firstly, this research identifies and analyses factors that ease the implementation of bioenergy high-tech, together with barriers and motivators behind bioenergy marketplace development within Africa and Ghana. Again, this current research also contributes to the literature on the bioenergy project revealing the obstacles in its implementation. Lastly, this contemporary study will help the government endeavor to include bioenergy shareholders in their policy development to integrate the industry's viewpoint into the process.

2. Literature Review

2.1 Genesis of Biomass

The word biomass comes from the Greek term "bio," which means "life" and "maza," denoting "mass." Thus, biomass means non-fossilized together with biodegradable organic materials from plants, microorganisms then animals (Kabyanga et al., 2018). Other definitions include "a renewable kind of energy generated from organic/inorganic substances; bioenergy use helps reduce the carbon content in the atmosphere, which is injurious to human health and environmental safety (Shane et al., 2017). Biomass materials include agricultural waste and biodegradable biological fractions on municipal and business waste. Biomass refers to renewable energy. Hence, the biomass found in plant material is made through photosynthesis. Carbon dioxide and water from the atmosphere are transformed, utilizing power from sunshine, into the carbohydrates that make up the plant.

Biofuels comprise a solid, liquid, or vaporous fuels produced from the extensive scope of biological matters known as biomass. Many biofuels like logs then fibrous substances can be utilized straightly as firewood sources by slight processing. However, different biofuels are generated from the biomass with the proper translation machinery to provide the energy in shape that is much suitable to bring the needed energy work. So, bioenergy is usually used to denote the biochemical power kept within biofuels (Ullah et al., 2021). Illustrations of biomass and its energy usage are shown in Table 1.

Table 1: Biomass and its energy usages

Type of biomass	Energy use
Firewood and logs processing trashes	burnt to heat constructions, make process heat in business, andproduce electrical energy.
Crops and refuse materials	burnt as gasoline and changed into liquid biofuels.
Food, backyard, and firewood trash ingarbage	burnt to produce electrical energy in power machines or changedinto biogas in landfills.
Animal dung and human droppings	Changed into biogas, which can be burnt as gasoline.

Source: Author's construct.

2.2. The Supply of Biogas

Landfill gas machinery is commercialized machinery in Australia used for generating small hot vapor from landfilled. The landfill vapor is created through the anaerobiotic rottenness of biological garbage dumped inside landfills (Nikolaidis, 2021). Again, it concerns mainly a combination of C2O and methane by approximately identical amounts. Lesser liquid-vapor and insignificant natural mixtures exist within the landfill vapor. So, a significant methane capacity of landfill vapor allows it to be used as firewood for electricity generation. The commercial exploitation of landfill gas as fuel needs to be removed out of landfill locations by a reasonably regular flow and excellence. The refined landfill gas remains used in gas locomotives or turbine generator sets (Nikolaidis, 2021). Figure 1 depicts a typical landfill site for energy generation.

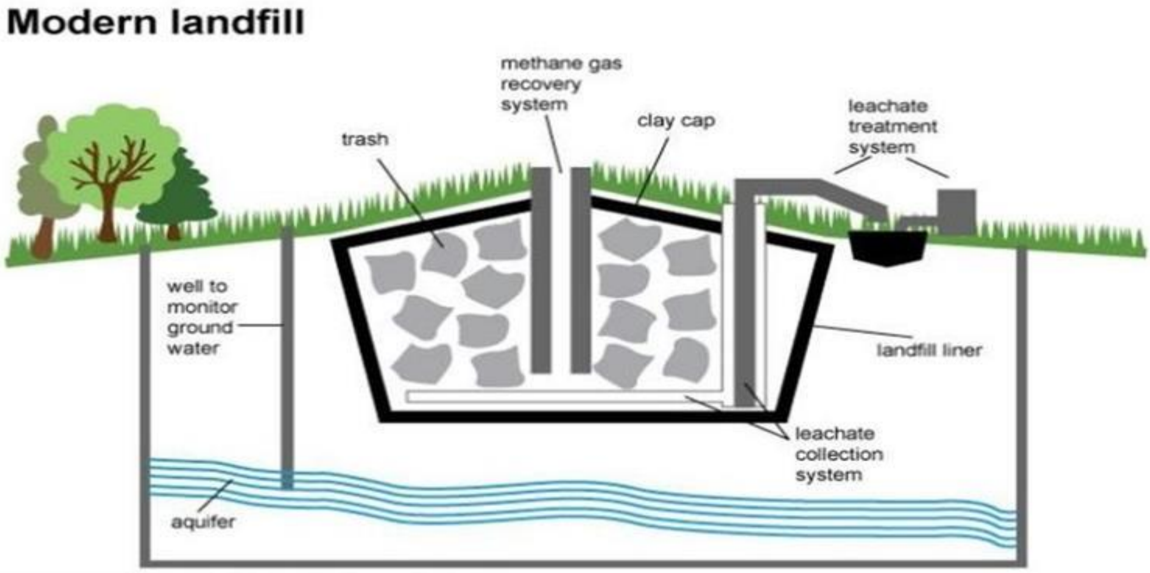

Figure 1: Typical Landfill site for energy generation

Source: (Nikolaidis, 2021)

2.3. The Supply of Biofuels and Bio-oil

The supply or generating of biofuels such as bio-oil, bio-diesel, bio-ethanol, then bio-methanol out of bioenergy, especially from implanted logs, is demanded to give several benefits on a broad national scale. The ecological importance includes decreased greenhouse discharges, lessened vehicle exhaust discharges, better inner-city air quality, upgraded soil constancy and potency, and weed control—the economic gains connected to the chances of providing workable financial options to current farming or forestry businesses. Several research and development (R&D) coupled with demonstration tasks are done US, China, Europe, and Australia (Stanturf & Mansourian, 2020; Moghtaderi et al., 2006). Bio-oil talks about the oils, which consist of benzene in addition to methylbenzene gotten out of biomass supplied right away from pyrolysis or indirectly through sorting out or refining tar compounds made throughout biomass gasification. Thus, bio-oil high-tech is experiencing commercialization. (Hu & Gholizadeh, 2019) incorporates waste to energy, reprocessing procedures, and progressive thermal translation to translate waste to beneficial energy forms comprising electrical energy and bio-oil. So, the waste substances exploited mainly include waste bioenergy, commercial, and business waste.

2.4. The Supply of Bioenergy Potentials in West Africa

Biomass is said to have the lion's share of most West African states' overall nationwide energy supply. Dependence on traditional biomass energy remains mainly higher with a record of 71-92% of principal energy supply then up to 97% of the overall homes' intake in other nations (Diouf & Miezan, 2019). Traditional bioenergy is regarded as free energy that denotes the fundamental energy basis for the underprivileged, particularly within the countryside and periurban regions. Still, oil-producing nations within West Africa persist in depending on bioenergy to meet the vast percentage of their home energy necessities (food preparation and warming). Nevertheless, the appraisal of the Policy Frameworks guide toward the deduction that in several nations, there is no precise strategy framework on bioenergy; hence, this subdivision is involved within the universal energy policy and strategy (Bello, 2020).

The conventional basis of energy continues to be the primary concern inside the energy policy. While the agricultural, forest, surroundings, and energy subdivisions stay incorporated, the relevant sector plans have advanced mainly in segregation without cross-sectoral partnership. The absence of meetings and harmonization will compromise the capability of every sector to attain its various policy goals (Ghana Energy Commission, 2020). Although Ghana is considered a middle- income nation as classified via the World Bank, Ghana's energy intake pattern is not different from persons of low- wages nations. Ghana's household energy needs are satisfied mainly by traditional biomass. Traditional biomass or wood-fuel, characterized in wood and charcoal, constitutes the more considerable portion of cookery and warming fuel supply in low-wage nations (Coelho et al., 2018). Wood fuel stays the primary cooking and warming fuel in Ghana, even at present accounting for nearly 74% based on the 2010 housing and population census (Ghana Energy Commission, 2020).

2.5. Ghana's Bioenergy Potentials

In Ghana, National Jatropha Plantation Initiative (NJPI) came into existence around 2007 through the final aim of increasing over a million hectares of JP regarding accessible indolent and devalued lands in stages for a subsequent 5-6 decades. The private initiative has progressed in recent times, and more than 20 businesses are farming huge lands of Jatropha plantations across Ghana (Präger et al., 2019). A projected 2.8 million hectares of the plot remains either beneath farming or reserved for Jatropha farming, signifying 12% of the entire land area than 20% of overall farming land. This speedy improvement is devoid of any law and supervisory outlines for bioenergy companies, and once the current forestry and farming laws do not include bioenergy subdivision. Bioenergy can be put into 2 classes: primary and secondary goods (Präger et al., 2019). Therefore, the direct goods derive from straight solar energy utilization, for instance, agricultural and forestry merchandise like fast-growing plants, energy lawn, vegetable remains waste from agriculture comprising chaff, and residual firewood from the forest (Perea-Moreno et al., 2019). Also, the secondary merchandises of bioenergy are made due to the decomposition of organic substances and other organisms such as animals, e.g., dung, solid waste, pantry waste, and trash. Recently they have come up with a deficiency of knowledge in the area of remains-based biofuel in the case of Ghana (Prager et al., 2019).

Moreover, these remaining energy possibilities stand a factor of 1,000, which is also small as equated to the job offered afterward (Präger et al., 2019). The potential on transports fuels centered around cassava and oil palm were scrutinized (Bawakyillenuo et al., 2021). Notwithstanding the seeming difficulties of land-use ups and downs, the researchers are calling for the usage of cassava starch utilizing respond to a decreasing oil supply in the future (Bawakyillenuo et al., 2021). Similarly, additional research examined the potential feedstock concerning ethanol manufacture in Ghana and discovered that the use of cassava tubers would be the most acceptable substrate in producing ethanol as an exchange for gasoline (Afolabi et al., 2021). Nevertheless, this study never considered the repercussions of using first-generation feedstocks regarding maintainable agrarian, food safety, and energy stability (Mensah et al., 2014).

The best extensive appraisal about bioenergy possibilities based on biomass remains was done by (Offei et al., 2021). The purpose of their research was to find the extent to which Ghana's energy demand can be satisfied by the lignocellulose remains, which includes the agricultural residues. The study approximates Ghana's bioenergy potentials grounded on comprehensive calculations using literature then scientifically based suppositions to compare the conversion of the remains into ethanol or biomethane (Odoi-Yorke, 2018). Also, the expected nationwide biomethane manufacture would be enough to substitute more than one-fourth of Ghana's current fuel-firewood usage. However, the projected cellulosic ethanol can cover over 70% of the transportation fuel, likened to energy maize content (Offei et al., 2021).

2.6. The Supply of Ghana Energy Intake –fossil/Renewable Sources

Ghana's energy subdivision supply is described by an enormous ascendency of conventional biomass resources (E. Commission, 2020). Regarding endowment and consumption, biomass (primarily wood fuels – firewood, charcoal, and also crop remains) happens to be a tremendous essential primary energy resource recording for 90% of the overall direct energy used in the residentials in Ghana within 2016 to 2019, commercial and service sector is the second-highest consumption of biomass energy intake recording 75% to 80% of overall energy usage between 2016 to 2019. The industrial sector remains the third-highest consumption of biomass, having 60% to 65% of total biomass consumption from 2016 to 2019. The agricultural sector from figure 2 below happens to be the minor sector that consumes biomass ranging from 0% to 10% from 2016 to 2019 (Ghana Energy Commission, 2020). Thus, the ascendency of bioenergy in Ghana's energy equilibrium is evident within all core areas of Ghana's economy, as displayed in Figure 2 below.

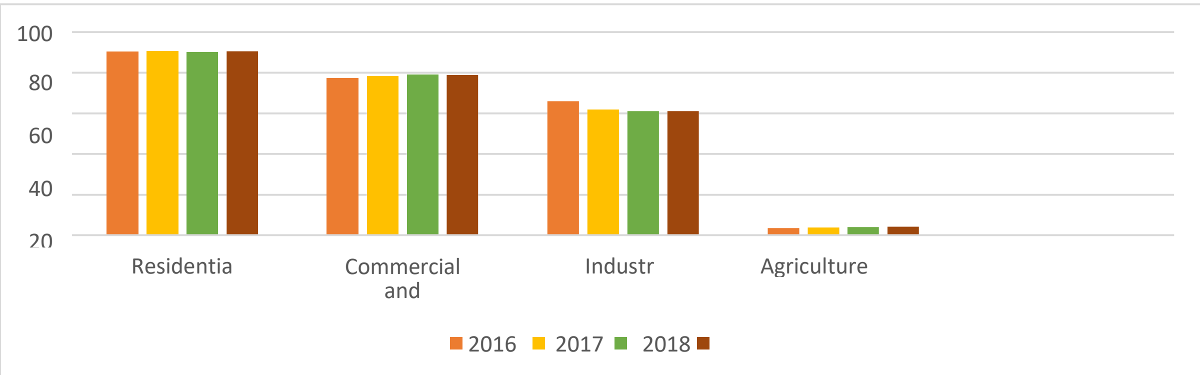

Figure 2: Percentage contribution of biomass to overall energy intake by specific sectors

Source: (Ghana Energy Commission, 2020).

2.7. The Supply of Petroleum

Petroleum is Ghana's most commonly consumed energy, bookkeeping for 47.6% of the overall ultimate energy spent within 2019 (G. E. Commission, 2020). Ghana imports entirely her crude oil wants and polished petroleum goods. But, a current finding of oil within the off-shore in Ghana around 2008 shows that Ghana shall become an oil-producing country in 2010, producing around 250,000 barrels of oil each day as reported by Ghana National Petroleum Company (GNPC), 2018. The unrefined oil brought in is polished at Tema Oil Refinery (TOR, Ghana), exclusively possessed by the state, with a volume of 46,000 barrels each stream day (G. E. Commission, 2020).

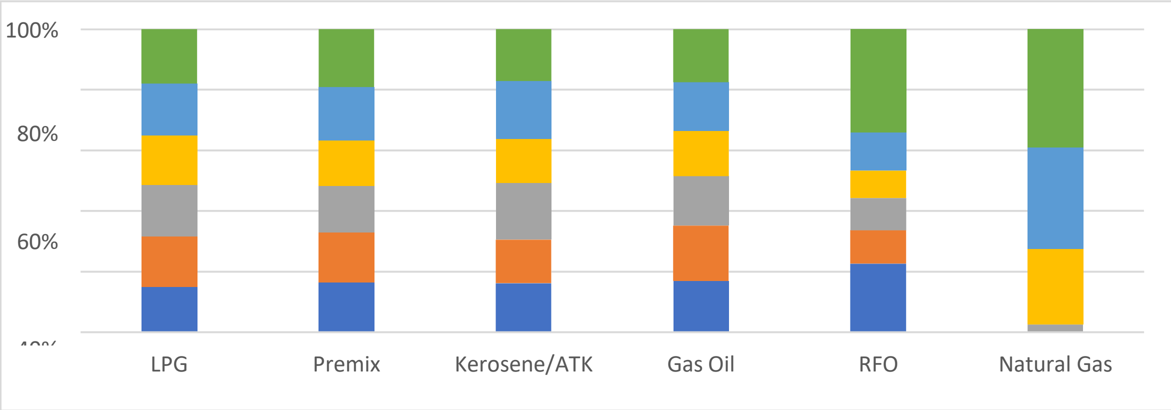

Figure 3: Consumption of petroleum products in Ghana from 2014 to 2019

Source: (Ghana Energy Commission, 2020).

2.8. Hydro Power Supply

Hydroelectricity is another most utilized energy source in Ghana. Two hydropower machinery, situated at Akosombo and so Kpong, joined to set up a volume of about 1,190 MW. This provides the majority (around 70%) of electrical energy generated within the state. The overall setup volume from thermic sources is projected around 860MW, taking to 2,105MW the general setup electricity volume in Ghana (Gyamfi et al., 2018). The Present-day electricity demand is launched around 1350 MW, implying an extra standby capacity available to Ghana.

Nevertheless, occasional drought and high petrol charges (that transforms into a higher production price tag from thermic source) irregularly make supply shortages, commonly added by importations (around 350 MW when accessible) from bordering Ivory Coast. Ghana is gifted with a reasonable portion of inexhaustible energy resources, like solar and biomass (Twinomunuji et al., 2020). Yet, almost entirely, these resources continue unexploited. The involvement of current inexhaustible energy in the national energy mixture remains minimal even though research has revealed that Ghana possesses respectable breeze speeds alongside her coastal belt. Hence, the wind energy perspective stays untouched. Even though there is an excellent quantity of biomass resources, generating current forms of energy, like electrical energy and warmth from bioenergy feedstock, is better defined as empirical. Equally, the little hydropower perspective of Ghana is unused (Twinomunuji et al., 2020).

2.9. The Present-day Condition of Bioenergy for Ghana

Ghana is far gifted with a sizeable quantity of bioenergy resources and may be controlled to generate contemporary energy. Bioenergy resources in terms of groups are grouped into 2 in Ghana: Controllable natural resources – wooded and non-wooded biomass resources.

Uncontrollable natural Resources – Sun, Air (wind), Rivers, and the Sea. Woody biomass includes wood fuels, timber, and sawmill remains, whereas non-wooded biomass consists of agricultural remains (plants and animal remains) and public (solid and liquid) wastes (Nienow et al., 1999; Wright, 2016).

3. Research Methodology

3.1. Data Collection and Sampling Technique

Primary and secondary data sources were used. Sampling within social research is hugely significant. It directs the researcher to decide the coverage concerning the study on the category and number of persons who need to be part of the study to make it satisfactory (Kumar et al., 2019). Also, sampling consists of two kinds, and using any one of the two rests on the research direction; however, scholars have frequently joined the use of the two, such as the instance of this paper. This research employs qualitative together with quantitative approaches. The study uses an interview guide and administering a survey to collect data from the 433 respondents; these questionnaires were distributed to Benso Oil Palm Farm (BOPF). The interview questions are advantageous in research because they help measure people's reactions by facilitating comparison and statistical aggregation of data and give broad illustrative findings from the respondents' point of view.

3.2. Data Analysis and Econometrics model

Qualitative data analysis was used for the respondents' responses to the interview questionnaires. Responses were classified, analyzed, and interpreted according to their meanings. Frequencies and percentages of respondents further helped in identifying the key issues. Our multiple regression equation is indicated in equation (1)

Econometrics model for the study

$BI = \alpha 0 + \alpha 1FSi + \alpha 2PWi + \alpha 3LFi + \alpha 4RDi + \alpha 5TNi + \varepsilon i(1)$

Where α is the constant

BI denotes Bioenergy Implementation FS is the financial support

PW denotes Political Will LF indicates legal framework RD denote research data

TN denotes technical know-how

Control ε is the error term

$\alpha 1$-$\alpha 5$ are the coefficients representing the magnitude and direction of the relationship between the dependent variable and independent for answering the research questions and the hypotheses.

4. Analysis and Discussions

4.1 A Case Study Company: Benson oil palm farm (BOPF)

The formation of bioenergy high-tech, the blending of knowledge and acquisition, is required in moving from vision towards realization. It comprises instructive prerequisites and work experience. Benso oil palm farms make oil palm, which is production then processing it. The procedure in employing fresh graduates from several schools in Ghana and likewise training them throughout internships, the topic of expertise is well addressed. Putting in measures that guarantee the constant progress and training of the company's labor supply base is the most outstanding progressive oil palm administration technique that makes workers of BOPF more efficient. BOPF deals in plant oil grinders, so they operate in a significant portion of the marketplace within West Africa. Again, the processing machinery of fats and lubricants and mixing is also a portion of BOPF's company. The business possesses a proprietary high-tech in changing wasted diet to wholesome diet.

Benso oil palm farm now produces above 18,200 metric tons of palm oil coupled with around 5,100 metric tons of palm fruit husks. Also, kernels are gotten from over 4,900 small-scale agriculturalists in the Central then Western areas stretching from their locality (Abasi), Beposo towards Mankessim and Elubo (Gabienu, 2012). Hence, the oil palm grinder approved around November 1981 has then been advanced between 15 to 19 metric tons for every 60 minutes grinding capacity. The business has strategies towards upgrading the 635kVA steam turbine energy-producing machine near 1350kVA. The basis of this energy employing fiber and shell produced from the grinding process by way of fuel for the boilers is a view as a low-priced source since it is an obvious instance of maintainable agrarian utilizing residue products for energy production. Each year, the lubricant grinder can handle 147,400 metric tons of fresh fruit bunches. The spreading of fresh fruit bunches varies between 6.4% throughout the month to 13.7%, the highest in 30 days. By (Gabienu 2012), the high value of palm oil is attained through early reaping and by sterilizing the fruit immediately after cutting.

In making this practical, a link around 407km highway is built inside the estates (Eduku, 2017). The high value of their palm oil is attained by early reaping and sterilization of the fruit immediately after cutting. To uphold their high oil excellence for many months of manufacture, the companies make certain a substantial excellence standard remains sure before shipment (Eduku, 2017).

Moreover, Agricultural Development Bank serves as the facilitator, whereas BOPF gives extension services and grants completely utilizing cash. Thus, the scheme is in four stages (1995

– 1998). The farmers were chosen from the localities, and the project is productive and expected inside the localities. Furthermore, reaping has been highly fruitful through the smallholder strategy; after that, a different 18,200 tones are reaped yearly (Amevenku et al., 2019). The company entered into a reforestation program as of 1998 by about 250 hectares annually. About 568 hectares (1420 acres) depicting 2005, 2006, then 2007 replants that remain in the undeveloped stage. Thus, the whole plantation might have been planted again in 2016. Figure 4 indicates a graphical representation of Benson Oil Company Oil palm fruit and oil palm residue after mills.

Figure 4: Benson Oil Company (A) Oil Palm Fruit (B) Oil Palm Residue after mills.

Source: Author's construct.

4.2 Empirical analysis

4.2.1 Profile of Respondent

Table 2 below illustrates the detailed information of the socio-demographic data of the 433 respondents of Benso oil company with the information covering (gender, age, educational level, and income level of respondents) (Amevenku et al., 2019). As seen from the table, out of the 433 respondents, 300 representing 69.3% and 133, which is 30.7%, were male and female who availed themselves for the survey. Again, regarding the age of the respondents, the table shows that many of the respondents were between 31- 40 years depicting (33.5%) followed by 20-30 years (26.6%) then 41-50, which is (21.9%) with 51-60 (18.0%) been the least. More so, the majority of the respondents, 193 representing (44.6%), hold WASSCE certificate followed by BECE (23.6%) and Master's degree been the last. Lastly, on the income level of the respondents, it was revealed that 167, which is (38.6% of) majority of the respondents receive a monthly salary between GHC 5,100

- 10,000 with the rest of the income level of the respondents displayed in the table below for reference.

Table 2: Profile of respondent

Background Information	Characteristics	F	P
	Male	300	69.3%
Gender of Respondents	Female	133	30.7%
	20-30	115	26.6%
	31-40	145	33.5%
Age of Respondents	41-50	95	21.9%
	51 and above	75	18.0%
	BECE	102	23.6%
	WASSCE	193	44.6%

Educational level	Diploma	100	23.1%
	Degree	23	5.3%
	Masters	15	3.4%
	Below GHC 1,000	54	12.4%
Income level	GHC1100-5000	112	25.9%
	GHC5100-10,000	167	38.6%
	GHC 10100-20,000	66	15.2%
	Above GHC 21,000	34	7.9%

Source: Author's field work (2022)

4.2.2 Pearson correlation analysis

Table 3 shows an inter-item correlation analysis that depicts a fair and positive correlation but a significant correlation among the dependent and independent variables at a 1% level—none of the variables negatively correlated with barriers in bioenergy project implementation. Lack of technical know-how had the highest Pearson's correlation coefficient r=0.716, followed by lack of research data r=0.359, inadequate financial facilities to support bioenergy Projects r=0.340, lack of political will r=0.311, and lack of legal framework r=0.009. The results from the various test were all accepted and used for this study. The findings show a positive relationship between Ghana's barriers to bioenergy project implementation and the independent variables.

The results from the analysis supported the independent variables: lack of technical know-how, lack of research data, lack of legal framework, inadequate financial facilities to support bioenergy projects, and lack of political will; the results from the Pearson correlation test showed that lack of technical know-how had the highest correlation; hence it is the factor with the most decisive impact on bioenergy project implementation in Ghana. This is reasonable and expected because a lack of technical know-how is necessary for Ghana's bioenergy project implementation. It forms the foundational requirement for the bioenergy project in Ghana. The person correlational analysis supported the lack of research data as a barrier to bioenergy project implementation in Ghana. This is empirically true in that there is not sufficient study in higher education establishments on bioenergy projects owing to non-support from responsible government departments. In some cases, authorities, organizers, and implementers concerning bioenergy projects regard higher education institutions as focusing too much on academics to the extent that they eliminate their involvement. Hence, it has been accredited to the little or no subsidy from the government regarding research and growth (Shane et al., 2017)

The correlational analyses supported the lack of political will as a barrier to bioenergy project implementation in Ghana. (Klagge & Nweke-Eze, 2020) contend that political will is amongst the significant reasons that have an essential effect on determining the extent of renewable energy in the national energy mix. Ghana's political willpower for bioenergy projects has fallen behind compared to other emerging nations worldwide. Lack of legal framework had the least significant relationship with barriers in bioenergy project implementation in Ghana. However, this finding was least expected since the legal framework helps the institutions reduce their risk of litigations.

Using Pearson correlational analysis, the model showed that lack of technical know-how, lack of research data, inadequate financial facilities for bioenergy projects, and lack of political will were significant at the 1% level of the analysis. However, the Legal framework showed a weak significance level at 1%.

Table 3: Correlation analysis

Pearson correlation	BI	FS	PW	LF	RD	TN
Bioenergy Implementation	1.00					
Inadequate Financial Support	0.34	1.00				
Lack of Political Will	0.311	0.38	1.00			
Lack of legal frame work	0.009	0.221	0.467	1.00		
Lack of research data	0.359	0.04	0.316	0.64	1.00	
Lack of technical know-how	0.716	0.614	0.54	0.13	0.30	1.00

Source: Author's field work (2022)

4.2.3 Multiple regression Analysis

The outcomes of the regression analysis are shown below. The data from the results supported all the variables except lack of legal framework.

BI = 5.45 + 0.0360 FS + 0.0320PW + 0.173LF + 0.402RD + 0.104TN

Table 4: Barriers of bioenergy project implementation in Ghana

	β	Standard error	t-value	P-value	VIF
constant	5.454	0.214	6.210	0.000	1.458
Inadequate Financial Support	0.360	0.360	3.874	0.003	2.511
Lack of Political Will	0.320	0.080	12.841	0.000	1.334
Lack of legal frame work	0.173	0.043	11.917	0.000	1.522
Lack of research data	0.402	0.002	9.118	0.000	2.301
Lack of technical know-how	0.104	0.012	8.003	0.000	1.471

Source: Author's field work (2022)

A stepwise regression analysis was conducted to assess the best predictors among the variables that could hamper Ghana's bioenergy projects, as indicated in Table 4. The results indicated inadequate financial support β = 0.360; $t - value$ = 6.210; P = 0.000) has a positive and significant relationship with the implementation of BI in Ghana. Again our study outcome shows that lack of political will β = 0.320; $t - value$ = 12.841; P = 0.000), lack of legal framework

β = 0.173; $t - value$ = 11.917; P = 0.000), lack of research data β = 0.402; $t - value$ = 9.118; P = 0.000) and lack of technical know-how β = 0.104; $t - value$ = 8.003; P = 0.000) significantly affect the implementation of BI. Table 4 further indicates that our research model lacks multicollinearity issues since all the co-efficient of the variance factor inflation (VIF) is less than 5, as suggested by (Harman, 1976).

4.3 Discussion

4.3.1 Financial Support and Bioenergy implementation

Inadequate financial support has a significant impact on bioenergy project implementation in Ghana, according to the results from the Pearson correlation analysis, which is supported by (Nevzorova & Kutcherov, 2019; Kitheka et al., 2019; Aha & Ayitey, 2017). Inadequate financial support is among the significant barriers to bioenergy implementation projects. Even though it is an effective means to use high technology and machinery to generate and save bioenergy, cost deliberations are crucial in commercial activities. Also, it costs a lot to purchase adequate information in addition to high-tech systems. In this modern time, finance is important to meet bioenergy projects' machinery and workforce requirements. Hence, it is unachievable to implement bioenergy project if there is no financial support from stakeholders and the government (Sansaniwal et al., 2017).

4.3.2. Political will and Bioenergy implementation

Klagge & Nweke-Eze, (2020) debate that political will is amongst the most significant reasons that have an essential effect on determining the extent of renewable energy in the national energy mix. Within Sub-Sahara Africa, the political will is renewable energy has fallen behind compared to other emerging nations elsewhere throughout the world. Political decisions supporting acceptance and implementation, training and mental ability building, flexible funding mechanisms, and dissemination plans are needed if bioenergy production is to help societies. Due to this, what is most likely required is to create an alertness program for the main frontrunners in politics and management to teach them the numerous benefits of successfully accepting and executing the biogas program in Ghana.

4.3.3 Legal framework and Bioenergy implementation

The lack of legal framework had the least significant relationship with barriers in bioenergy project implementation in Ghana. However, this finding was least expected since the legal framework helps the institutions reduce their risk of litigations which is in line with the conclusions from (Agyekum, 2020). Also, it is impossible to execute a bioenergy project without the backing of an appropriate legal policy framework. Therefore, it is essential to establish a legal framework in which bioenergy saving will be applied and advanced well (Chiaramonti & Goumas, 2019).

4.3.4 Research data and Bioenergy implementation

The person correlational analysis supported the lack of research data as a barrier to bioenergy project implementation in Ghana. This is empirically true in that there is not sufficient study in higher education establishments on bioenergy projects owing to non-support from responsible government departments. In some cases, authorities, organizers, and implementers concerning bioenergy projects regard higher education institutions as focusing too much on academics to the extent that they eliminate their involvement. Hence, it has been accredited to the little or no subsidy from the government regarding research and growth (Shane et al., 2017).

4.3.5 Technical know-how and Bioenergy implementation

The lack of expert and knowledgeable technical professionals to carry out the building and upkeep of bioenergy machinery is a constrain impeding the full spreading and adoption of bioenergy production within developing nations (McCollum et al., 2017). Higher education institutions in Sab-Sahara Africa have not planned and implemented suitable programs in teaching and training learners in bioenergy technology. Occasionally there is an essential technical skill in operating and maintaining a bioenergy digester. Thus, (Gagné & Fent, 2021) supported that poor quality types of machinery because of inexperienced advisors and contractors, inferior quality building materials, and lack of know-how about bioenergy production systems have negatively affected bioenergy adoption and implementation.

5. Conclusion and Policy Implications

The barriers' analyses comprise case industries from Ghana situated at Benso oil palm farms. The case industry utilizes forestry farming resources such as palm kernel missiles and fiber—the main barriers comprising progress then dissemination of energy schemes in Ghana. Thus, a robust bioenergy scheme should give electrical energy, hotness, and then fuels for transportation. This collaboration among the firms inside the bioenergy company stands exceptionally dominant in the achievement of bioenergy companies. Concerning a bioenergy company towards advancing, corporations should be established between the bioenergy industries. Another development is that it is constantly problematic to collaborate among bioenergy industries and governmental establishments. This discusses the problems facing bioenergy industries inside Ghana. Also, it adds to the recognition scrutiny and the discussion on the barriers known within the case industry.

The empirical outcome of our study revealed that bioenergy implementation is affected by critical barriers such as financial facilities, technical know-how, research data, proper legal framework, and political will. The study suggests that political decisions supporting acceptance and implementation, training and mental ability building, flexible funding mechanisms, and dissemination plans are needed if bioenergy production is to help societies. This is reasonable and expected because a lack of technical know-how is necessary for Ghana's bioenergy project implementation. It forms the foundational requirement for the bioenergy project in Ghana. The Pearson correlational analysis supported the lack of research data as a barrier to bioenergy project implementation in Ghana. This is empirically true in the sense that there has not been sufficient study in higher learning establishments on bioenergy projects owing to non-support from responsible government departments. In some cases, authorities, organizers, and implementers of bioenergy projects regard higher education institutions as being too scholarly to the extent that they eliminate their involvement. Hence, it has been ascribed to the little or no subsidy from the government regarding research and growth (Shane et al., 2017).

The correlational analyses supported the lack of political will as a barrier to bioenergy project implementation in Ghana. (Klagge & Nweke-Eze, 2020) a debate that political will is amongst the most important reasons that have an essential outcome in determining the amount of renewable power in the national energy fuse. In Ghana, the political will for bioenergy projects has fallen back behind compared to other emerging nations elsewhere in the world. Lack of legal framework had the least significant relationship with barriers in bioenergy implementation (Lima, 2021). Controlling methane produced by animal compost within Ghana, Togo, Nigeria, and Senegal bioenergy project implementation in Ghana.

5.1. Policy Implications

The study examined and discussed how Ghana's supply of bioenergy implementation could remain free from the usual strain presently being met via government, stakeholders, and business professionals. Because of that, several policy implications are being outlined: Higher training institutions should formulate and structure bioenergy programs for higher learning. Legislative reform is required to form a legal framework to protect entrepreneurs and investors willing to invest in bioenergy projects. Government and NGOs should see the need to look for international funding; financial facilities should be made adequate for the supply of bioenergy projects implementation. Also, it implies that governments must endeavor to include bioenergy shareholders in their policy development to integrate the industry's viewpoint into the process. The study recommends that political decisions supporting acceptance and implementation, training and mental ability building, flexible funding mechanisms, and dissemination plans are needed if bioenergy production is to help the societies.

Data Availability

The data sets employed during this study are available from the corresponding author upon reasonable request.

Conflicts of Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this research.

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