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Review Article

An Overview of Scientific Production of Renewable Energies in Ghana

Mohammed Takase and Rogers Kipkoech

Department of Environmental Science, School of Biological Sciences, College of Agriculture and Natural Sciences, University of Cape Coast, Cape Coast, Ghana

Correspondence should be addressed to Mohammed Takase; mohammed.takase@ucc.edu.gh

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Ghana is experiencing an increase in energy demand as a result of increased industrialization activities. Nonrenewable energy sources, such as combustible fuels like petroleum, are the primary source of energy. Nonrenewable energy resources are associated with a number of issues, including environmental pollution. Renewable energy is a sustainable source of energy that is critical to the energy sector and the economy's progress. Hydropower, biomass, solar energy, and wind energy are among the renewable energy resources available in Ghana. In Ghana, key institutions are responsible for the management and development of energy sources in the renewable energy sector. Among these institutions is the Ministry of Energy, which is responsible for the formulation and implementation of laws and policies, for instance, the Renewable Energy Act of 2011. Volta River Authority (VRA), Ghana Grid Company (GGC), and Electricity Company of Ghana (ECG) are among the institutions under the Ministry of Energy. There are also regulatory agencies established by parliamentary act to ensure that all actors in the sector are working properly. Among these are the Energy Commission, the Public Utilities Regulatory Commission (PUR), and the National Petroleum Authority. Active nongovernmental organisations (NGOs), research institutes and universities, and industry are also involved in renewable energy activities.

1. Introduction

There is a rising demand for energy occasioned by rapid development of economies due to many countries becoming industrialized [1]. Energy demand in the future is likely to increase more, compared to the current state partly due to the exponential global population growth [2]. Continuous price increases, volatility in the world's crude oil economy, and distribution uncertainty have all fuelled interest in the search for alternative fuels [3]. The search for alternative energy sources has led to the discovery of renewable energy sources, such as biofuel, which is an excellent alternative energy source that can compete with fossil fuels in terms of efficiency and availability [4]. There are three types of energy resources: renewable, nonrenewable, and nuclear [2]. Using nuclear energy can result in the adverse effect on environment and human health. The main source of the energy in many countries is from combustible fuels which are currently on demand. Large-scale use of fossil fuels results into many challenges which include environmental pollution, depletion of global petroleum reserves, and many other challenges in the recent years [5, 6]. The reserve for the fossil fuels is not ubiquitous but is limited and is constantly decreasing. Among the negative impacts of using fossil fuels include effects of climate change, depletion of ozone layer, acidic rain in addition to a rapid increase in the amount of greenhouse gas emission, and the rise in the prices of fuel [7, 8].

Renewable energy source is a sustainable energy which can provide energy over long period of time, and it is affordable, useful in any task, and without negative environmental impact [3, 9]. Based on various researchers, renewable sources of energy are clean and produce minimal secondary waste and negative environmental impact. Therefore, it is considered to be sustainable according to existing economic and social needs of the present and future. To combat

increasing effects of climate change due to the rising amount of emission, there has been an increase in diversity of supply in energy options with the aim of reducing dependency on fossil fuels, creating jobs and new export markets for energy, and lowering emission of greenhouse gases, and these efforts have not yield much results. Renewable energy is vital to the progress of energy sector in Ghana, in replacing the petroleum fuels obtained from fossil materials, and whereby its continued usage significantly contributes to climate change and thus results in global debate. Despite the abundance of renewable energy, Ghana has witnessed little development of renewable energy sector [7].

Ghana is one of the countries in Africa that is facing the rising demand of energy, compared to the supply from the past decades. The country, however, possesses immense fields of renewable energy which have not been developed due to lack of finance and expertise. Ghana is substantially endowed with potential sources of energy resources which are made up of hydroresources, solar, ocean energy, biomass, and wind. Despite all these resources, only biomass energy is used and it is estimated to account for more than 40% of the total energy supply in the country. A plan has been implemented by the government to ensure reliable supply of energy and avoid overexploitation of forest for economic and social purposes [10–12]. The Government of Ghana, therefore, through the plan affirmed its commitment in ensuring sustainability in energy sector through development of a productive usage of renewable energy resources to address increasing demand for energy and mitigation of climate change, hence resulting into creations of green jobs for the people of Ghana [13].

The Government of Ghana has put forward the definition of the major targets in all sectors of the energy, which relates to the global pattern. The intention was to ensure provision of electricity to all its population by the end of 2020. The vision of the government is to guarantee every sector of the economy with energy services that are reliable and of high quality and to facilitate the exportation of power to other close countries. Sources of renewable energy in Ghana have been recognized as among the promising choice for the energy's security and management of environment with the purpose of alleviating adverse effects of climate change, ensuring access to affordable, reliable, and sustainable modern energy by the year 2030 as stated in the 7th Sustainable Development Goal (SDG). It is therefore necessary to provide additional impetus to the generation of renewable energy and usage for the development of Ghana in terms of socioeconomic though marketing of renewable energy system is still on-grid with connection to the power plants and off-grid with connection to system domestic residents and institutional usage, communal water system, and irrigation [14].

The study is aimed at presenting a clear overview of the renewable energy resources available, the status of the current power generation and application, the renewable energy projects which are still under development, and the constraints to the development of the renewable energy in Ghana. The information for the study was obtained from various sources which were academic articles, websites, books, government reports, and research reports. Accurate academic literature on renewable energy in Ghana was obtained by using keyword search on famous search engines which were Google Scholar, ScienceDirect, and Web of Science. Peer-reviewed academic information was also used in supplementing the work.

2. An Overview of Renewable Energy Sources in Ghana

According to the Renewable Energy Act of 2011 (Act 832), sources of energy such as hydropower, ocean energy, solar, biofuel, wind, and geothermal are classified as renewable source of energy, and it is designated in writing by the Minister of Energy. Ghana has abundant renewable energy and should be harness with an aim of achieving sustainability in development. The main renewable energy resources that exist in Ghana include hydropower, biomass, solar energy, wind energy, and ocean energy [7, 15].

2.1. Solar Energy. Generating electricity using solar photovoltaic (PV) is one of the feasible renewable energies which can enhance supply of the electricity used for various purposes such as pumping water with energy-powered surface water pump, solar cooker, and many other applications [16–18]. The development of this resource from PV system is now being given attention in Ghana. Solar energy, for instance, is used for street lightning, and it has been accepted by the Government of Ghana in addition to other projects that have been commissioned in place such as Accra-Nsawam Road [19, 20]. A solar PV farm with capacity of 20 MW has been installed in Onyadze in Gomoa East to provide electricity services to the communities in these areas.

Several companies have been licensed by the government to build solar farms in Ghana, and this has attracted a lot of interest. The location of Ghana in the tropics enables it to have abundance of solar radiation between 4.0 and 6.5 kWh/m^2/day. The annual duration of the sun ranges from 1800 to 3000 h per year. The highest amount of solar radiation is received in the northern part of the country. A small pilot project of 2 MW solar PV grid-connected plant was built by the Volta River Authority (VRA) in the Upper East Region. The VRA sought concessionary funding to enable it further establish additionally 8 MW plant. Ghana's photovoltaic solar energy plant, which is under the construction, is projected to be the largest in the entire Africa and ranked 4th in terms of size globally [7, 20].

Potential of solar energy is estimated to be 35 EJ (exajoules) and can be harnessed to supply almost 100 times the energy requirement of a country with an estimate of 53,000 MWh per year with an assumption of 2670 annual average working hours. The northern part of Ghana consists of the Northern, North East, Upper East and West, Savannah, northern part of Bono East, Bono, and the Oti regions which is experiencing 4.0-6.5 kWh/m^2/day on average per month of solar radiation which is considered the highest in the entire country. Solar thermal power plants take advantage of the direct (beam) component of solar radiation. The direct (beam) solar radiation is strongest in the northern

part of Ghana. Flat plate solar collectors and PV modules are unaffected by the diffuse fraction and can thus be used effectively throughout the country [21].

Ashanti, Ahafo, Central Region, parts of Volta, Western-North, Bono, and Eastern receive solar radiation ranging from 3.1 to 5.8 kWh/m^2/day on average compared to Greater Accra, Volta Region, and Western parts of Central which receive solar radiation of 4.0-6.0 kWh/m^2 on average in a month as shown in Figure 1 [21–23].

2.2. Hydropower. Hydropower has been used for many years as the only source of electricity in Ghana and was mainly obtained from Akosombo Dam which had a capacity of 1020 MW and was constructed in 1966. Ghana generates more than 2000 MW from hydropower, and about 1200 MW is obtained from traditionally large-scale hydropower sources. The rest is generated from smaller- to medium-scale hydropower sources. A total of 800 MW remaining is from 70 small sources which produces less than 1 MW and the medium hydrosites that generate between 1 and 100 MW. The small hydropower is majorly centred within, Central Region, Eastern Region, Ashanti, Bono-Ahafo region, and Volta Region. The two large-scale hydropower stations are the Akosombo and the Kpong dams. The two dams combined generate 65% of entire hydropower generated in the country. The major challenges limiting the exploitation of hydropower in Ghana are climate variability, prolonged construction of the new hydropower plants, and lack of data required in accessing the viability of the sites [24, 25]. In order to deliver a more resilient and dynamic energy sector, the government is focusing on securing electricity supply through diversification. The government's target is to increase non-hydrorenewable energy supply by 10% by 2025. This renewable energy for electricity is expected to come primarily from solar, wind, biomass, and municipal solid waste, but smaller-scale hydropower plants are also expected [26]. Figure 2 shows the hydropower sites with the exploitable capacities

The challenges of unavailability of crucial data to determine the viability of the site for hydroelectricity are being addressed through the following initiatives started in 2015 by the Government of Ghana in partnership with donor agencies [15, 28]:

(i) The Government of Switzerland provides funds to a Hydropower Sustainability Assessment Project (HSAP) on the six hydropower sites located in black and white Volta Rivers. These sites are Lanka, Ntereso, Koulbi, Daboya, Kalpawn, and Jambito with a total of 362 MW as the exploitable capacity

(ii) The Agence Francaise de Development (AFD), the World Bank, and the Volta River Authority (VRA) together fund different aspects of ongoing feasibility studies on the Pwalugu (40 MW) and Juale (90 MW) hydropower sites

(iii) China Water Electric (CWE) and Bui Power Authority have funded the complete feasibility study of Hemang (60 MW potential) hydropower project

(iv) The African Development Bank and Ministry of Power are preparing to commission prefeasibility studies on 10 more small and medium hydropower sites which have a total capacity 248 MW which can be exploited

In line with Ghana's efforts to achieve universal access to electricity by 2020 by connecting communities that cannot be cost-effectively reached by conventional grid-based rural electrification, private sector participation and investment resulted at least 20% of the remaining unelectrified population being connected to the electricity grid. Expansion of private sector participation and investment in the country's electricity sector was achieved through the initiatives started in 2015 by the Government of Ghana in partnership with donor agencies. The creation of an enabling environment to encourage private sector participation was key to the government's strategy [28].

2.3. Wind Energy. Ghana has great potential for wind energy that can be used in generation of large amount of electricity. The potential of the wind energy technically is estimated to be almost 5000 MW. According to the research, eastern coastal areas and hill tops around Lake Volta and border of Togo in Ghana have the greatest potential of the wind power. Variation of the wind speed is experienced in different parts of the coast, ranging from 3.33 to 6.08 m/s [29].

The amount of electricity generated by a turbine is largely determined by wind speed. Because stronger winds allow the blades to rotate faster, higher wind speeds generate more power [30]. The preferable height above sea level for installing large-scale wind power plant project is from 50 m, and at this height, wind speed is considered as moderate to excellent since wind speed of 7.1 to 9.0 m/s is recorded. Wind energy had been neglected for a long time in Ghana; until recently, it receives attention as a cheap renewable energy as compared with other renewable energy based on several researches carried out. And a number of assessments have been carried out systematically in Ghana for the past 20 years to establish potential of wind energy. Traditionally, Ghana Meteorological Services Department measures wind data in Ghana, and based on its observation, the speed of the wind in most of the parts of the country is from 1.7 to 3.1 m/s at a height of 2 m according to the collected data from 22 synoptic stations, which is crucial in determining the areas that are suitable for establishment of wind power project to generate electricity [29].

Adaramola et al. *[31]* conducted research that reveals that economic feasibility of wind energy in Ghana is dependant specifically on factors such as type of turbine deployed by the developer, site evaluation, cost of materials, wind speed, land topography and geology, distance, and turbine size. The study evaluated potential of wind energy and economic viability of deploying separate wind turbine for electricity generation within the seven Ghana's coastal sites selected. The sites were Ada Foah, Warabeba, Aplaku, Mankoadze,

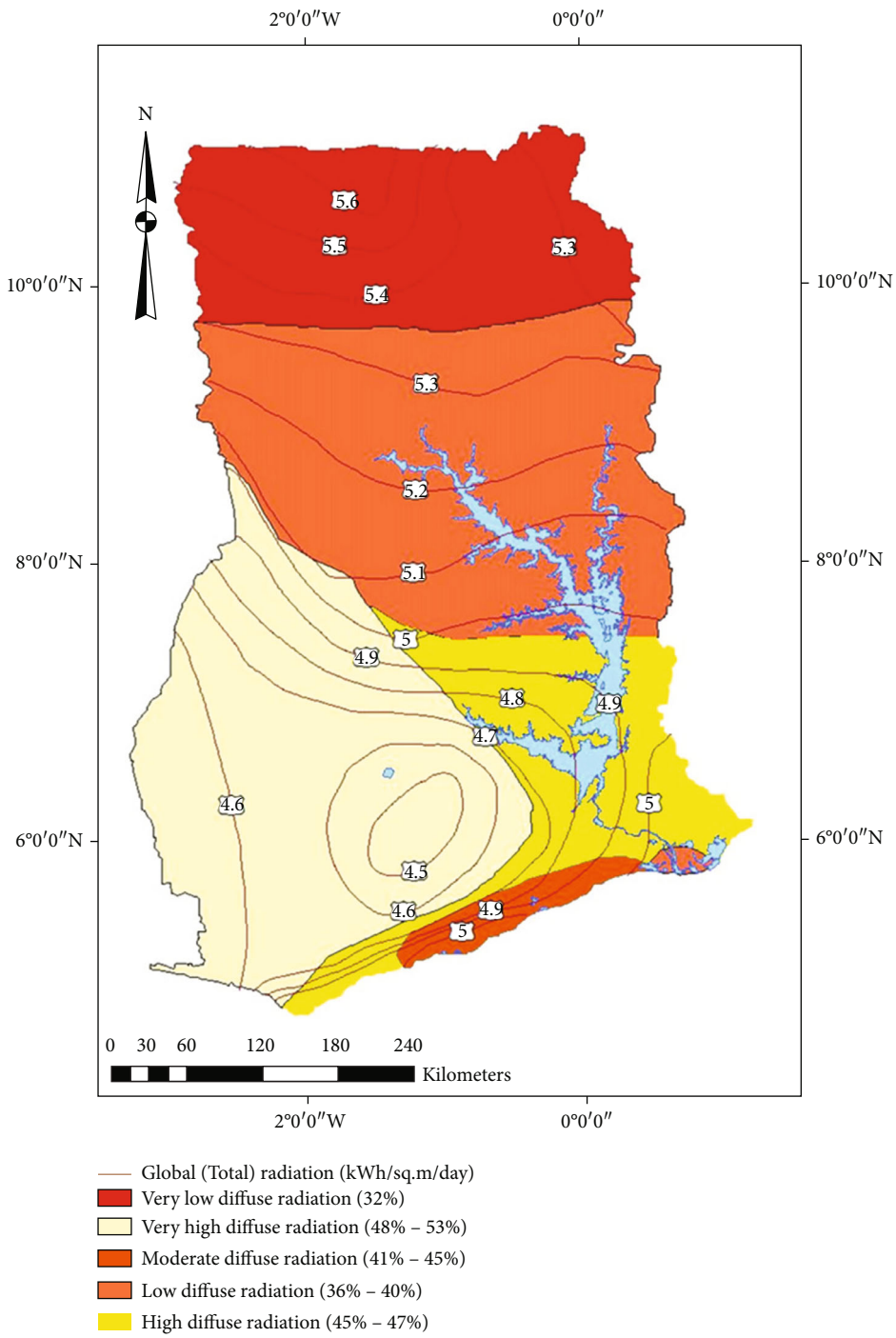

Figure 1: Solar map of Ghana [23].

Oshiyie, Lolonya, and Anloga [31]. Ghana Energy Commission undertook wind speed measurement at these sites in different regions of Ghana, and the wind speed was taken at the height of 12 m for the sites. The sites were chosen based on their annual average wind speeds which is a representation of Ghana's climate [32].

Based on Adaramola et al. [31], the areas' selected places were categorized to possess low to medium wind speed regimes. As per the existing data, researchers were selected to carry out economic analysis on the chosen small to medium size commercial wind turbines to find out the best alternative, so that the government and the stakeholders' plans on investment in wind energy resources can be guided. The performance and economic efficiency for four small commercial wind turbine models ranging from 50 kW to 250 kW, namely, Polaris 15-50, CF-100, Garbi-150/28, and WES 30, as per the order of the size was analysed by the researchers. There were cut-in wind speeds and moderate wind speed ranging from 2.2 to 2.7 m/s and 9.5 to 13 m/s correspondingly. The research established that there was a

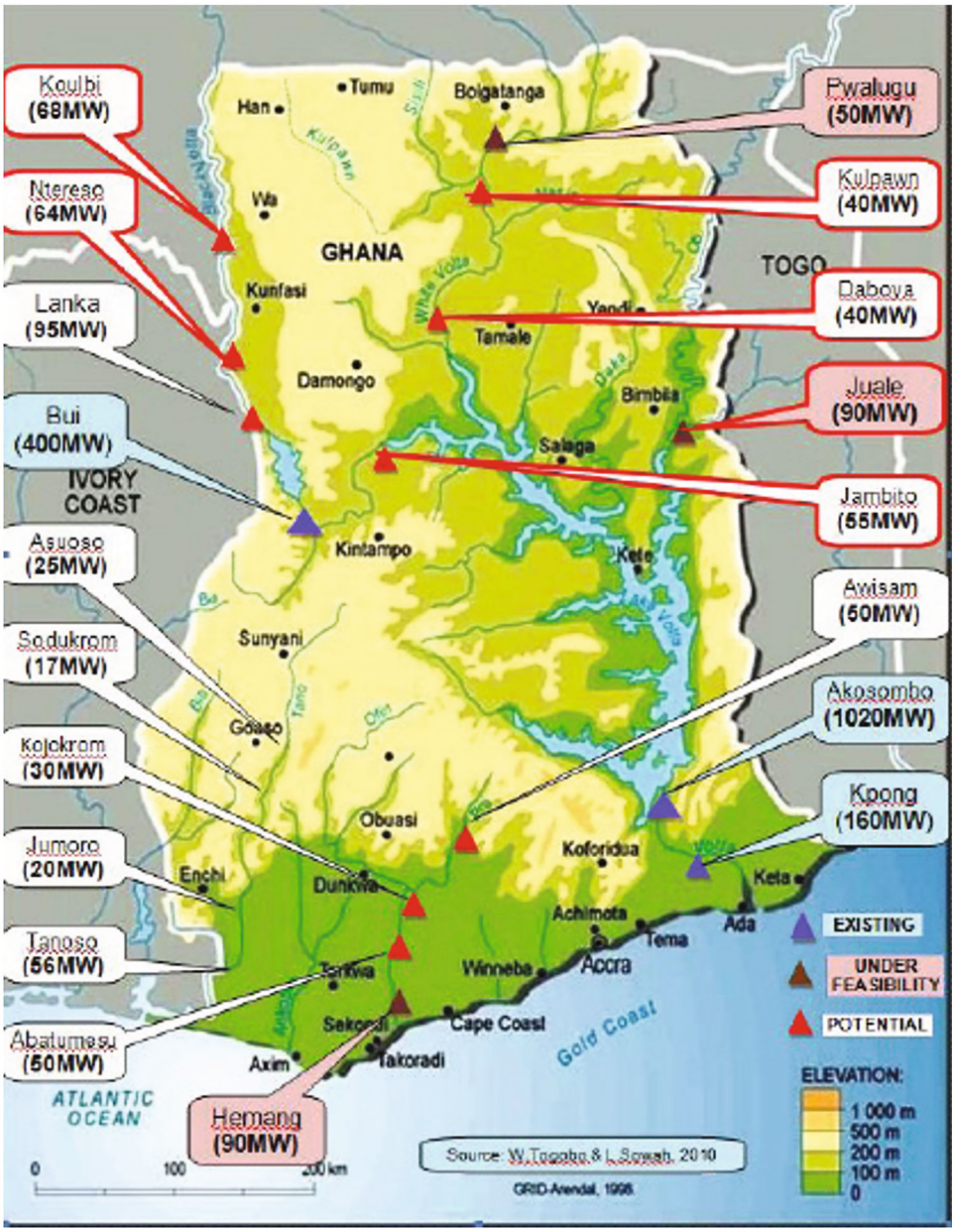

Figure 2: Existing and potential hydropower sites in Ghana [27].

positive correlation between the output of the electricity by the wind turbine and the size of turbine, as the site marked WES 30 produced the greatest output in all the sites. It was also identified from the study that wind energy has not significantly penetrated into the Ghana energy market and, thus venturing in it, has no shortage of interest. The VRA has completed the erection of 100 MW wind power plant in Kpone; at the same time, it has also undertaken scoping studies in construction of a 150 MW plant, to be divided equally among communities in the Volta and Greater Accra Region [31]. The main barriers to the development of the projects have been lack of credible data, high initial investment costs, limited experience and lack of track record of wind projects, high perceived risk of a new regulatory regime, and limited access to long-term cost-effective project financing [33, 34]. In spite of these barriers, there is no doubt that the potential of wind energy in the coastal regions of Ghana is likely to be high and encouraging, and in presence of the suitable policies and the incentives put in place, it can produce tremendous output for the coming decade in pursuit of the Sustainable Development Goal (SDG) number seven in Ghana [31].

Based on the research by Essandoh et al. [35], the site wind speed data was collected at 12 m a.g.l., and Mankoadze had the highest annual average wind speed of 6.1 m/s, while Oshiyie and Warabeba had the lowest average wind speed of 3.9 m/s. Figure 3 depicts the specifics. Anloga had a higher annual average wind speed of 5.4 m/s compared to 3.9 m/s at Amedzofe for the sites where wind speed data was collected at 20 m a.g.l.

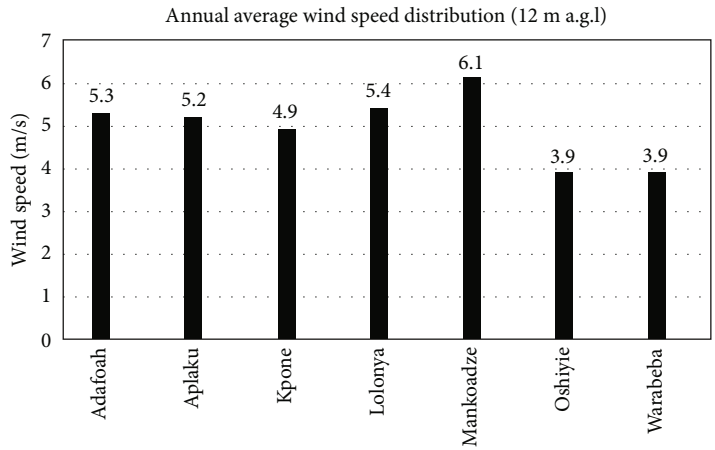

Figure 3: Annual average wind speeds data of the site over a monitored period (12 m a.g.l.) [35].

2.4. Biomass. The term biomass is used to describe every plant, algae, microorganism, and animal. Biomass resources encompass a wide range of product which include wastes from farming activities, wastes produced from processing food and from animals, municipal solid wastes, and residues from the timber. Biomass is the world's fourth most abundant energy resource, and several economic and environmental benefits can be obtained from biomass resources [36–38]. In Ghana, one-third of the total agricultural land area is covered by the vegetation. One of the major economic activities in Ghana is farming in forest areas, and majority of the cash and food crops are grown in those areas. Almost 40% of the households in Ghana are using wood for cooking while close to 33.7% use charcoal. Charcoal is produced from wood; usually, acacia plant and the saw dust that have been compressed are the preferable source of energy for cooking among the rural communities and in the low-income urban areas. Charcoal is produced and sold over a long distance in Ghana, mostly in the central and the northern regions. For decades, it has been relied upon as a major source of energy in Ghana. According to the data available, biomass such as wood is gradually losing its dominance in Ghana's consumption of energy from previous usage of about 46.7% to 40% currently which is in accordance with the government plan to reduce its usage [39, 40].

Strategies have been set up for attracting biomass and bioenergy investment sector, through encouraging planting of trees which is one of the simplest and most effective ways of tackling climate change. In addition, it boosts rural energy development and creates jobs and lowers a burden of inadequate energy supply to meeting the demand [41]. Ghana has large arable and mass of land that has been degraded and can be of huge potential in planting trees and cultivation of crops and plants that can be turned into various solid and liquid biofuels. Biomass is the major energy resource in Ghana in regard to production and consumption, with the two primary consumed biofuels including ethanol and biodiesel [42]. Figure 4 shows biofuel production, transportation, and consumption in Ghana [7, 43].

3. Key Institutions in Ghana's Renewable Energy Sector

The management of energy system in Ghana is through the public sector. The Ministry of Power has a responsibility of carrying out formulation, implementation, monitoring, and evaluation of power sector policies. The VRA and Bui Power Authority are utilities owned by state and are generating electricity supply in bulk. Ghana Grid Company (GRIDCo) has a mandate of managing the national transmission and system operation and supply of electricity to the industries and mining sector in addition to the two VRA electricity distribution companies which are Electricity Company of Ghana (ECG) and Northern Electricity Distribution Company (NEDCo) [15, 44].

The VRA has diversified its power generation portfolio in order to capitalise on readily available and sustainable energy sources, primarily hydro and natural gas and renewables. The authority owns and operates a total installed capacity of 2,532 MW of electricity generation capacity. The two main hydroplants on the Volta River, Akosombo and Kpong generating stations, have 1,020 MW and 160 MW, respectively. These are supplemented by a 2.5 MW solar PV plant in Navrongo, Upper East Region; a 6.5 MW solar PV plant in Lawra, Upper West Region; and a 13 MW solar PV plant in Kaleo, Upper West Region [45].

The financial situation that prevailed in 2018 had a significant impact on GRIDCo's operations. The approved transmission tariff was reduced by 50% when compared to the previous year's tariff. The Transmission Service Charge (TSC) was a significant factor in GRIDCo financial performance. GRIDCo submitted two (2) tariff proposals to the Public Utilities Regulatory Commission (PURC) in 2018 [46]. A number of projects could not be completed due to GRIDCo's ongoing financial difficulties. A number of issues related to the company's financial challenges impacted and continue to impact GRIDCo's normal operations [46]. VRA and GRIDCo should upgrade and expand various facilities to improve generation and reliability of power supply in the country [7].

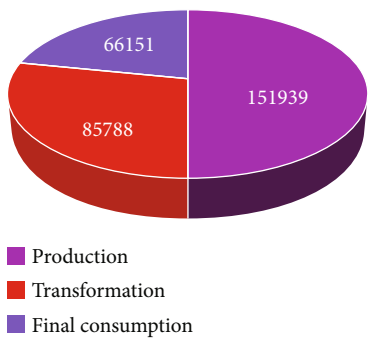

Figure 4: Biofuel production, transformation, and consumption in Ghana [7, 43].

Some of the regulatory agencies have been set up through the act of parliament. The aim is to ensure all players engaged in the sector of energy are working well and the creation of conducive environment for the protection and enhancement private investment. The agencies are the Energy Commission, the Public Utilities Regulatory Commission (PUR), and the National Petroleum Authority. The Energy Commission gives advice to the government on policy and strategy on energy. In addition, it carries out the indicative planning of energy and electricity system expansion and licensing energy sector operators [47]. PURC is a prime body that was established in 1997, and it sets the tariffs and frame customer service regulations. The National Petroleum Authority is an independent regulator which is reviewing development of world market price, the imported finished product's prices, and the functions of Ghana's oil refinery [47–49].

In the latter half of 2020, the PUR Commission supplemented its digitisation with limited physical monitoring exercises while adhering to the COVID-19 protocols. The commission discovered some operational challenges faced by utilities through these routine monitoring exercises. Measures to address these issues were developed in collaboration with the utilities. The promulgation of Consumer Service Regulations (L.I. 2413) increased the effectiveness of the commission's enforcement measures. This regulation is intended to assist the commission's directorates in addressing challenges encountered in their field and investigative work. The regulations, which were later made law, also include a schedule of charges that will be used as administrative penalties against defaulting utility companies [50].

The energy sector has many active nongovernmental organisations (NGOs), research institutes and universities, and industry associations involved in a variety of activities. These activities include promotion of the renewable energy, research, and deployment [7, 48, 51]. Table 1 gives the list of the institutions that have the function that are most influential in the renewable energy trajectory in Ghana and brief description of their functions.

4. Renewable Energy Policy

The Renewable Energy Act of 2011 was passed into law with the aim of providing legal and regulatory frameworks

Table 1: Key institutions in Ghana's energy sector [51].

Institutions	Functions
Policy and regulation	
Ministry of Energy (ME)	Formulates, implements, and evaluates power sector policies
Energy Commission (EC)	Licenses, regulates, and monitors energy service providers, develops indicative national energy plans, and advises the minister on the energy policy
Public Utilities Regulatory Commission (PURC)	Regulates tariffs and enforcement of customer service obligations of all public utilities and IPPs
National Petroleum Authority (NPA)	Regulates, oversees, and monitors activities in the downstream petroleum industry
Petroleum Commission (PC)	Regulates and manages the utilization of petroleum resources and coordinates policies on petroleum resources
Environmental Protection Agency (EPA)	Distributes, monitors, and enforces environmental policies, including the energy sector
Ghana Investment Promotion Centre (GIPC)	Encourages and promotes investments in Ghana, providing for the creation of an attractive incentive framework and a transparent, predicable, and facilitating environment for investment
Implementation	
Volta River Authority (VRA)	Generation and transmission of electricity
GRIDCo	Electricity transmission services
Electricity Company of Ghana (ECG)	Distribution of electricity in southern Ghana
Northern Electricity Department (NED)	Distribution of electricity in northern Ghana
Tema Oil Refinery (TOR)	Crude oil and petroleum product import, crude oil refining and bulk sale of petroleum products OMCs and bulk consumers
Ghana National Petroleum Corporation (GNPC)	Oil and gas exploration
Bulk Oil Storage and Transportation Company (BOST)	Planning for laying and managing strategic petroleum product stocks
Oil Marketing Companies (OMCs)	Distribution and marketing of the petroleum product
Education and research	
The Energy Center, KNUST	Carries out research, development, demonstration, and educational activities in energy technology, policy, and management
University of Energy and Natural Resources (UENR)	

Table 1: Continued.

Institutions	Functions
	Provides training in science, technology, and management of energy and natural resources
Council for Scientific and Industrial Research (CSIR)	Pursues the implementation of government policies on scientific research and development
Nongovernmental organisations	
KITE	Energy policy studies and analysis/clean energy enterprises development
Association of Ghana Solar Industries (GSI)	Promotes and raises the profile of solar industry, improves quality, develops standards, and arranges renewable energy training
Energy Foundation	Promotes energy efficiency/ conservation measures and renewable energy technologies
New Energy	Develops and implements clean energy initiatives
CEESD	Dedicated to technologies that offer engineering solutions to climate change, energy poverty, and environmental degradation

needed for the development and expansion of Ghana's subsector of the renewable energy. Various sectors of the economy have also implemented policies having component on development and utilization of substitute energy specifically renewable energy. The act recognizes renewable energy as the sources of the energy that cannot be depleted, for example, hydro, ocean energy, biofuel, landfill gas, biomass, wind, solar, and geothermal. Renewable energies are available in abundance in Ghana and can be harnessed with the aim of attaining sustainability in the development. The key renewable energies in Ghana consist of hydro both small or mini and medium capacity, biomass, solar energy, wind, and tidal energy. The act is based on the following premise: attaining long-term demand through the use of public, private, and foreign investment; accelerating the privatization activities; and ensuring optimum and sustainable development and operation of all renewable energy sources [52].

5. Contribution of the Research

The research seeks to contribute to the knowledge by providing useful information on the renewable energy resources which are available in Ghana, the state of exploitation and generation of power, development of renewable energy projects which are still in progress, and the challenges faced in the development of the renewable energy sector in Ghana. The information is therefore useful to the government in planning to meet targets ensuring universal access to affordable, reliable, and modern energy services. The provision of energy services contributes directly or indirectly to poverty alleviation.

To stimulate economic growth and reduce poverty, Ghana's government launched the Ghana Poverty Reduction Strategy (GPRS) in 2001 as a strategic framework to address both economic growth and poverty reduction. The Ghana Poverty Reduction Strategy is aimed at moving Ghana from a low-income to a middle-income status by 2012 with a target of around $1,000 per capita. This transformation necessitates energy-intensive economic activities such as job creation, improved educational quality, and reaching out to communities where the national electricity grid is inaccessible or through decentralised sustainable energy systems that are already in place [14].

6. Conclusion

The article examined the available renewable energy resources, the status of current power generation and application, the renewable energy projects that are still in the development stages, and the constraints to the development of renewable energy in Ghana. In many countries, fossil fuels are the primary source of energy, which is currently in high demand. The reserves of fossil fuels are scarce, limited, and constantly depleting. In Ghana, there is an increase in the diversity of energy supply options, resulting in less reliance on fossil fuels, job creation, new energy export markets, and lower greenhouse gas emissions, which cause climate change. Ghana, as one of the African economies, is experiencing an increase in energy demand relative to supply over the last few decades. Hydropower, biomass, solar energy, wind energy, and ocean energy are the primary renewable energy resources present in the country. Renewable energy sources in Ghana have been identified as a promising option for energy security and environmental management with the goal of mitigating the negative effects of climate change. Moreover, the Renewable Energy Act of 2011 (Act 832) defines renewable energy as energy sources that cannot be depleted, are abundant in Ghana, and can be harnessed. To ensure access to affordable, reliable, and sustainable modern energy by 2030, as stated in the 7th Sustainable Development Goal (SDG), it is necessary to provide additional impetus to renewable energy generation and usage for Ghana's socioeconomic development. In Ghana, the energy system is managed by the government. In addition to the two VRA electricity distribution companies, ECG and NEDCo, GRIDCo is responsible for managing the national transmission and system operation, as well as the supply of electricity to the industries and mining sector. Some of the regulatory agencies were established by legislation. The Energy Commission, PUR, and the National Petroleum Authority are the organisations. Many active nongovernmental organisations (NGOs), research institutes and universities, and industry associations are involved in a variety of activities in the energy sector.

Data Availability

Data used for research is embedded within the manuscript.

Conflicts of Interest

The authors declare that there are no conflicts of interest.

Acknowledgments

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