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Electricity and informal settlements: Towards achieving SDG 7 in developing countries

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ABSTRACT

Despite many academic discussions on the importance of sustainable and reliable energy to informal settlement dwellers, there is limited evidence on the delivery of electricity in informal settlements, especially in Sub-Saharan Africa. Using the concept of tactical urbanism, this study examined electricity delivery and access to informal settlement dwellers in Accra, Ghana as an important component of meeting SDG seven. The paper analyses evidence collected through three focus group discussions of thirty informal settlement dwellers in three communities in Accra. The findings showed that whereas access to electricity in informal settlements has improved significantly, this increase is a result of corruption and connivance with electricity officials and that informal settlement dwellers pay exorbitantly to access and use electricity. This paper contributes to the growing body of scholarship on sustainable electricity in urban informal settlements in the Global South by documenting the experiences of informal settlement dwellers in Accra, Ghana.

1. Introduction

Access to reliable, affordable, and sustainable energy is a must for meeting the Sustainable Development Goals (SDGs) as energy is intricately linked to almost all the SDGs [1,2]. Despite this, access to reliable and sustainable energy is still a major challenge, especially in developing countries. For instance, evidence showed that over a billion people live without access to electricity, while another billion suffer poor quality service — the majority of whom live in peri-urban or rural areas of sub-Saharan Africa and South Asia [1,3,4]. This has the potential to deprive many of the several opportunities that come with access to electricity such as healthcare, education, transportation, communication and many more. In relation to this, access to reliable and sustainable energy in informal settlements has taken a center stage [5]. About 80 % of people projected to be without access to electricity live in rural areas or informal settlements [1]. Whereas such people are already at a disadvantage, this essentially further worsens their already precarious socioeconomic status.

Informal settlements constitute the fastest growing and the most common form of urban habitation in Ghana. It is estimated that 45 % of the urban population in Ghana lives in informal settlements [6]. Accra which is the Capital City of Ghana possesses the largest number of informal settlements. It is estimated that nearly one-third of the population of Accra lived in informal settlements [7]. In their 2016 research titled "Know Your City", Peoples Dialogue counted 265 informal settlements in the Accra Metropolitan Assembly (AMA) alone. One of the major challenges in informal settlements in Accra is access to sustainable and reliable energy [8]. However, research has established a positive impact of sustainable and reliable energy on the health, education, quality of life, universal welfare, and socio-economic development of informal settlement dwellers [9,10]. On the whole access to sustainable energy in informal settlements especially in developing countries remains a great challenge [10].

Despite many academic discussions on the importance of sustainable and reliable energy to informal settlement dwellers [11–13], there is limited evidence on the delivery of electricity in informal settlements, especially in Sub-Saharan Africa [1,10,14,15]. To address this gap in the extant literature, this study examines electricity delivery, access and challenges to informal settlement dwellers in Accra, Ghana as an important component of meeting SDG seven. Specifically, this study examined access to electricity in three informal settlements in AMA — Agbogloshie, Chorkor and Avenor which are the most deprived and excluded informal settlements characterized by poverty and large agglomerations of dilapidated housing, a situation that makes it difficult for settlers to access official electricity. Using the concept of tactical urbanism, this paper addresses two core questions: how do informal settlement dwellers navigate access to electricity and what are the challenges they encounter in the process? The paper analyses evidence

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collected through three focus group discussions of thirty informal settlement dwellers in three communities in Accra to document how they access electricity and the challenges thereof.

The findings showed that whereas access to electricity in informal settlements has improved significantly, this increase is a result of corruption and connivance with electricity officials and that informal settlement dwellers pay exorbitantly to access and use electricity. This paper contributes to the growing body of scholarship on sustainable electricity in urban informal settlements in the Global South by documenting the experiences of how informal settlement dwellers navigate access to the urban infrastructure [16,17]. The rest of the paper is structured as follows: Section 2 provided literature on informal settlements and access to sustainable energy and reports on the situation in Ghana. Section 3 describes the methodology and data used while Section 4 discusses the results and Section 5 presents the conclusion and some policy recommendations.

2. Informal settlements and sustainable energy

For the past two decades, informal settlements have become a common practice in the Global South, typically believed as the outcome of an enforced need for shelter by the urban poor communities [18]. Current estimates showed that one billion people live in informal settlements across the globe with most of them located in developing countries [19]. Furthermore, informal settlement dwellers account for 238 million people in Sub-Saharan Africa today, almost a quarter of the global total and 54 % of the African urban population [20,21]. It is projected that informal settlement dwellers will increase to two billion by 2030 and three billion by 2050 especially if the current trends persist [22]. This situation will put more pressure on urban infrastructure, especially in informal settlements where residents already have little access to them.

There are many definitions of informal settlements in the literature, however, the definition by the UN-Habitat is one of the most widely used definitions. According to the [23] "informal" settlements are residential areas where (a) inhabitants have no security of tenure vis-à-vis the land or dwellings they inhabit, with modalities ranging from squatting to informal rental housing, (b) the neighbourhoods usually lack, or cut off from, basic services and city infrastructure and (c) the housing may not comply with current planning and building regulations and is often found in geographically and environmentally hazardous areas. Similarly [14] refers to informal settlements as densely populated settlements that lack basic property rights and access to critical infrastructure such as clean water, sanitation, and energy, among others. Generally, definitions of informal settlements range from settlements that lack basic services to a lack of recognition by the state or city authorities.

A key basic resource that is lacking in informal settlements is access to sustainable and reliable energy. Nearly 1.3 billion people continue to remain without access to electricity [24]. Most of the world's urban population does not indeed have access to electricity. For instance, about 40 % of the world's poor living in urban areas lacks access to modern energy services that could improve living conditions and expand economic opportunities. Thus, while informal settlement residents lack basic services in general, the absence of reliable electricity serves as a significant barrier to their ability to escape poverty and live safe, healthy, productive lives [19]. Indeed, many of those in direst need of electricity are located in rapidly growing informal urban settlements throughout developing countries [25]. In poorer regions of the world, however, access can be illegal, expensive, and potentially unsafe [10].

However, sustainable, and reliable energy is imperative because access to sustainable energy in informal settlements enhances the general well-being and improves the socio-economic development of informal settlement dwellers [12]. Energy is central to meeting basic human needs and improving living standards. Households require energy for the essential services of cooking food, heating water, space heating and illumination to satisfy basic human needs. Despite this informal settlement dwellers lack some level of access to a sustainable and reliable supply of electricity and especially affordability. Not affordable, people living in informal settlements usually spend over 30 % of their income on energy services [10,12]. This further drains their meagre savings and deprives them of a decent life in already expensive city life.

Unable to acquire electricity legally, informal settlement dwellers could devise a way to have access to such an important necessity of life. As noted by the concept of tactical urbanism [26], informal settlement dwellers devise ways to improve their existing situation or initiate new ways to enjoy necessary social services in an urban setting. Citizens, in this case, informal settlement dwellers tend to tactics because regulations on access to electricity may take longer or may not be favourable to them [27], meanwhile they believe they are entitled and exercising their right to the city [26]. Tactical urbanism is defined by [26] as "an approach to neighbourhood building and activation using short-term, low-cost, and scalable interventions and policies." According to [26] such "interventions include illegal, unsanctioned, bottom-up initiatives as well as formal, city-led programs and policies."

3. Sustainable energy to informal settlements and achievement of SDGs

Globally, the achievement of SDGs 7 and 11 - of ensuring modern energy access to all and creating cities that are inclusive, safe, resilient, and sustainable can rarely be achieved without a sustainable energy policy [13]. Research has established a positive impact of energy on health, education, quality of life, and well-being [10,28,29] improving the universal welfare and socio-economic development of the dwellers of informal settlements [10,11]. To this effect, the need for energy in the informal settlements is not only for its direct benefits on health and welfare but serves as a gateway for other kinds of development including increased access to information, facilitation of education, and reduced workload for certain mechanical tasks [30].

This makes it imperative that an improvement in the lives of informal and slum dwellers through the supply of clean, reliable, and affordable energy is seen as a multi-stakeholder purpose [23,31] intended at enhancing the social, economic, physical, environmental and governance dimensions of the urban poor rights to a city. Collaborating on the above submission, [30] assert that even though electricity is not only correlated with income growth, it also allows better access to information, education, and increases the quality of life. Within this context, it can be surmised that the negative effects arising from the lack of electricity access to informal settlements and slum dwellers cannot be computed. As a result, low-income slum dwellers spend a high proportion of their income on energy when compared to the non-poor [32,33]. Suggesting that the absence of electricity in the slums and informal settlements lead to illiteracy, high infertility, infant mortality, and low life expectancy [34]. As a result, [13] indicated that SDG 7 cannot be achieved without a combination of national and local energy policies.

4. Electricity in Ghanaian informal settlements

According to [35], whereas 88.2 % of informal settlements have access to electricity, only 46.2 % of them acquired their electricity connection directly and legally from the Electricity Company of Ghana (ECG) and thus had electric meters. The remaining 53.8 % connected through their neighbours' electric meters, a phenomenon that is referred to in the informal settlements as 'by-pass' and considered illegal. Thus, [36] found that the lack of attention by the energy authorities has perpetuated the illegal tapping of electricity in informal settlements. Similarly, [37] reports that clandestine electricity connections are common across many poor areas throughout the city of Accra. This illegal connection has created some debt in the energy sector through energy losses. For instance, [38] reports that about 30 % of electricity supplied in Ghana is lost through theft and other illegal activities.

Illegal connections further have implications for human lives. Indeed, [39] found that human lives were lost through electrocution or fire outbreaks because of illegal electricity connections, a situation that is attributed to consumers, staff of utility companies, and their accredited agents [40]. The fact that informal settlements are becoming widespread in Accra and their lack of access to sustainable and reliable energy calls for deliberate state policy to address their energy needs.

According to [41], most enterprises operating in informal settlements are energy dependent which further means that poverty reduction can be realized if there are sustainable and reliable forms of energy for productive uses. Interestingly, the various energy policy documents in Ghana (e.g., Strategic National Energy Plan, 2006–2020; National Energy Policy, 2010–2015) have not paid the needed attention to informal settlements and considering the way informal settlements are springing up, it is an issue of concern. Therefore, access to energy in informal settlements for productive purposes must be carefully considered when designing or formulating national and local energy policy interventions.

5. Methodology

5.1. The study context

This study focuses on three informal settlements (Agbogloshie, Chorkor and Avenor) in the AMA representing the three sub-metropolitan assemblies — Ablekuma South, Ashiedu Keteke, and Okaikoi South respectively. Agbogbloshie evolved as an indigenous Ga community, a kilometre west of central Accra. The community dates to the period before the 1920s when it was a part of the first "*Native Town*" in the colonial capital of Accra under the then British colonial administration [42]. The first inhabitants of Agbogbloshie were believed to have moved from the cluster of coastal Ga communities around the Ga Mashie area, to trade with the early European merchants who had settled in central Accra from the late 1870s. Agbogbloshie can be classified as a migrant community and there has been a plan to relocate the residents to other parts of Accra. It is, however, not certain if this would be carried out.

Chorkor is one of the oldest estates built by Dr Kwame Nkrumah, the first president of the Republic of Ghana for the military after the colonial masters left Ghana, the then Gold Coast. Subsequently, the estate became an alternative settlement for the people of James Town to ease housing pressures due to overcrowding. Presently, Chorkor is one of the oldest indigene communities in the AMA. It shares boundaries with Korle Gonno to the east, Agege to the west, Mamprobi to the North and the Atlantic Ocean washes its southern boundary. The main occupation of the people is fishing. Most of the men in the community are fishermen and the women are fishmongers. Avenor is a small settlement close to the largest transport terminal in Accra (Kwame Nkrumah Circle). It is one of the known informal settlements with high poverty levels in the Okai Koi South Sub-metro. Projection from the 2010 Population and Housing Census estimates the population of Avenor at 28,362 with many involved in petty trading, food vending and other menial jobs.

These informal settlements are the most deprived and excluded characterized by poverty and large agglomerations of dilapidated housing. In addition to tenure insecurity, people in these settlements lack a formal supply of basic infrastructure and services and are constantly exposed to eviction, diseases, and violence. In 2016, Peoples Dialogue conducted a total census in these areas and the result showed a lack of basic services such as water, electricity, educational facilities, and sanitation, among others [8]. These areas are characterized by all the ills associated with slums such as high population, inadequate supply and access to services, and a sense of tenure vulnerability, despite being indigenous.

5.2. Data collection and analysis

This study employs a qualitative research design as it seeks to explore deeper meanings than to quantify and generalise. A qualitative approach enables the researcher to gain an in-depth understanding of the phenomenon under study [43] - electricity delivery and access to informal settlement dwellers in Accra. The study used both secondary and primary sources of data as this offers a unique strength to deal with a full variety of evidence – documents, artefacts, interviews, and observations [44] and serves as a way of triangulation. The secondary data comprised Ghana's Strategic National Energy Plan 2006–2020 (2006), the National Energy Policy Plan (2010), the National Electricity Scheme (2010) and the Renewable Energy Act (2011). Primary data for the study was gathered through focus group discussions (FGD) with informal settlement dwellers in the three selected communities.

The selection of the participants was assisted by the representative of Peoples Dialogue, an NGO that focuses on informal settlements in Ghana. Peoples Dialogue has conducted enumerations of informal settlements in specific areas in Accra [45], the whole of Greater Accra [8] and later conducted a national survey of informal settlements in Ghana. Peoples Dialogue has therefore become one of the reliable organisations to obtain data on informal settlements in Ghana. One hundred households each were randomly selected based on an enumeration area map of the three studied areas. One person was then conveniently selected from the households based on their willingness and knowledge about the electricity situation in their household. In total thirty respondents participated in this study, comprising three focus group discussions.

Two University of Ghana students were trained for the FGD while Peoples Dialogue representative was used as a point of contact for entry into the informal settlements. The team was led by Accra's Chief Resilience Officer. The FGDs were conducted in English, guided by an interview guide, very interactive and engaging, lasted between 2 h and 3 h, and were audiotaped. The interview guide focused on access, delivery, and challenges of electricity in informal settlements. Thematic analyses were used to identify, analyse and describe patterns within the data [46], to ensure that logical deductions and conclusions are drawn from the data. In addition, verbatim statements were used to substantiate the arguments being made.

6. Findings of the study

6.1. Sources of energy for various uses

Energy is very important and has become part of our daily lives as it is used in almost all homes. There is ample evidence suggesting that access to reliable, efficient, affordable, and safe energy can directly affect productivity, income, and health, and can enhance gender equity. In the three informal settlements studied, it was found that the use of charcoal for cooking is more dominant across the entire community followed by firewood, gas stove (LPG), rice cooker, electric stove, kerosene, and plastic cast respectively. Respondents indicated that they prefer using charcoal and firewood for cooking rather than electricity due to the high electricity tariff. This is because a household with large family size, a typical characteristic of informal settlements, will find it extremely difficult to use electricity for cooking as they cannot afford the bill.

Discussants submit that electricity remains their main source of energy for lighting, ironing, freezing food, and powering television. The use of generators and torchlights is common when there are power outages normally for commercial activities. Lanterns and "*aboboya*" are also used especially in public toilets and when there are power outages. The use of car batteries is largely for purposes of charging phones and providing energy to television sets during periods of power outages.

6.2. Access to electricity and challenges

The FGD sought to find out if discussants have access to electricity. It was found that discussants have access to electricity except for those individuals who cannot afford the cost involved in accessing power from

ECG, the main distributor of electricity in Ghana. The ECG has a laid down procedure to acquire electricity and individuals who want to access electricity must follow these procedures, especially the submission of supporting documents such as land title, site plan, and building permit. What was rather intriguing was the fact that most of the informal settlement dwellers do not qualify for electricity per the laid down procedure for acquiring electricity in Ghana even though they have electricity in their homes. It was discovered that they got access to electricity through the support and connivance of electricity officials and middlemen.

As a result, the discussant indicated it was not easy to access electricity from ECG. This is because the procedure is cumbersome, and they cannot meet most of the requirements for accessing electricity. Commenting on the difficulties of accessing electricity, a discussant remarked: "*as for the electricity it is there, but to get the meter is extremely hard unless through giving them some bribe, you pass through potholes and mountains before getting light to your home*". The nature of informal settlements particularly how it is crowded makes it difficult to connect electricity. There are not enough electricity poles in the settlements, and it is often the case that the nearby pole is far from one's residence. When this is the case, the applicant must bear whatever cost it will take to get electricity to their homes. As indicated by this respondent: "*We are asked to buy electric poles and wires to connect power from the main source to our households*". This reflects the magnitude of the difficulty that informal settlements/slum dwellers go through in accessing electricity to their dwellings.

6.3. Corruption and middlemen - way of accessing electricity in informal settlements

Land title, site plan, and building permits are some of the key documentation requirements for accessing electricity in Accra. However, discussants of the FGD indicated that it is difficult to get those documents for many reasons. First, most of the dwellers do not have land titles, site plans, and building permits. Second, some of the structures are bad, temporary and face imminent eviction. Third, is the negative perception of informal settlement dwellers that they are engaged in illegalities, electricity theft, and bad structures. Because electricity is important to informal settlement dwellers, they find different ways of going around this cumbersome procedure and inability to meet the requirements.

Some discussants indicate that they use "*middlemen*" who help them acquire meters from ECG and connect electricity to their homes. These middlemen are bribed to circumvent the rules and get them electricity. It is imperative to note that these middlemen can be ECG officials, people who know ECG officials or some individuals who have gained notoriety as meter contractors. A discussant made this comment "*if you want to get a meter to your home, you have to grease the hands of ECG officials, it is as simple as that because if you want to follow the procedure, you won't get it*". Another discussant put it this way "*the process is too bureaucratic and takes a long time, you just have to grease the hands of middlemen or officials and you will have light in less than a week*".

Findings emerging from the FGDs in Chorkor showed that the ability of informal settlement dwellers to grease the palms of electricity officials and middlemen is the reason why they have access to electricity. About using all sorts of means to get electricity, a respondent stated as follows: "*if you have money, you can get everything, it is the ability to pay a bribe*". Another added, "*there is a squatting place close here, they live in kiosk, but they still have meters*". It also emerged that most discussants have a strong suspicion that ECG officials intentionally prefer the informal more than the formal approach. As one discussant put it: "*when you go formal, they say they don't have meters but when you go informal you easily get it*".

6.4. Illegal connections and tapping electricity from other houses

Illegal electricity connection is of greatest concern to all including electricity companies, and residents as illegal connections sometimes cause fire outbreaks. Despite the availability of electricity in all three studied informal settlements, the complex procedure, unnecessary delays, and the cost involved in the entire value chain of acquiring electricity poses challenges to informal settlement dwellers. Therefore, the findings revealed that informal settlement dwellers resort to illegal connections and tapping of electricity from nearby homes. It was found that illegal connection comes in various ways which may be difficult to detect.

For instance, there is the "*U-connection*", that is behind the meter connection where they use the electricity but do not get billed because the connection has bypassed the meter. Discussants at Agbogbloshie indicated that illegal connection is done through what they called "*office pin connection*". This happens when people take advantage to use an office pin to tap electricity from a wire that is passing at the back of their wall. The FGDs at Agbogbloshie and Avenor revealed that some officials from ECG help informal settlement dwellers do illegal connections.

There is a practice in informal settlements where electricity is tapped from other houses when a house doesn't have an electricity meter. The findings point to the fact that tapping electricity from other houses is very common in the three studied informal settlements. Several reasons were given for this practice - principal among them was the fact that informal settlement dwellers are unable to fulfil all the requirements that will enable them to get their electricity meters. Second, discussants indicated that in some cases, the main pole to connect electricity to their house is far and when this is the case, the applicant is asked to buy an extra pole. When the applicant cannot afford it, they resort to tapping electricity from other houses.

Again, it was found that there are debts on some electricity meters especially the post-paid meters and when that happens some members of the "*compound house*" decide to tap electricity from a nearby house to escape payment of the debt. Furthermore, discussants blame the high incidence of tapping on the huge cost involved in getting electricity meters from the ECG and the excessive bureaucratic processes. Interestingly, in Chorkor, a respondent hinted that "*tapping*" has become a source of income for some residents in the community. He explained that if a household taps into another household's meter, it comes with a fee or charges that the former pays to the latter based on certain agreed terms. This serves as an incentive to many households to offer their electricity meters for "*tapping*" since it can generate some income.

Despite the prevalence of this practice, it emerged that ECG frowns on it and views "*tapping*" as illegal, though officials of the ECG sometimes allow it by taking bribes from the residents when they detect it during their periodic inspection. Thus, a discussant remarked, "*We have been warned not to connect electricity from other houses, but people do it and sometimes with the support of ECG officials*". Perhaps, a major challenge in "*tapping*" is the determination of how much should be paid monthly/weekly by the one/house tapping the electricity. In Agbogbloshie, discussants revealed that some neighbours use their discretion to determine a fixed rate or amount to be paid by the "*tappers*" at the end of every week/month. Others also allot some fixed amounts to electricity gadgets such as light bulbs, fridges, TV, electric iron, and therefore weekly/monthly rates will be based on the number of gadgets one has.

6.5. Electricity connection, tariffs, and rates

The connection of electricity to the homes of informal settlement dwellers was a major issue. The findings showed that whereas the cost of a meter and connecting it to electricity is GHC 400, discussants mostly end up paying above GHC 2000. This means that informal settlement dwellers pay about 500 % of the cost of connecting electricity. This is due to several reasons including paying middlemen, and illegal meter acquisition. Similarly, because of the unplanned nature of informal settlements, there are not enough electricity poles, and, in such instances, applicants must buy the poles and power cables by themselves to connect electricity. This eventually makes the cost of connecting

electricity very high for informal settlement dwellers. In some instances, because they find it difficult to get electricity meters and even buy poles where the distance from an existing pole is far, applicants resort to tapping electricity from close by houses.

Apart from the cost of connecting electricity, there is also the issue of electricity tariffs and rates. Discussants indicated that electricity tariffs and rates are very high in Ghana and thus make it difficult for most of them to access it. This somewhat explains the reason most informal settlement dwellers would prefer illegal connections. At Agbogbloshie, a discussant stated: "*I use just one fridge, a ceiling fan, two bulbs, and a television set and every month, I pay GHC 190*". Another one remarked, "*I pay GHC 120 a month for two rooms, I don't have TV, no fridge, just three bulbs and three ceiling fans*". Discussants have attributed this to the prepaid meters and averred that the prepaid meters are killer and that it is too expensive to use them. Some discussants even believe that the prepaid meters are faulty. This is clearly expressed by this discussant: "*when I am travelling, I turn off all the gadgets in the house, but I still pay the same amount at the end of the month. I think the pre-paid meters are adjusted to disadvantage residents, particularly, those of use in slum communities*".

The cost of electricity tariff and the rate is also influenced by connecting through an existing electricity meter of a nearby house and direct connection without an electricity meter. In the case of the former, the owner of the meter decides how much should be paid monthly based on several factors such as the number of appliances one uses. A major challenge is the lack of transparency as the owner of the meter decides how much they should pay. This result in the exploitation of the poorest by informal resellers of electricity, charging more than double the official electricity price. In the case of the latter, some electricity officials connect households to electricity direct without a meter. In that case, they are made to pay a flat rate at the end of the month which is determined based on the number of rooms and appliances in the household. According to discussants, electricity officials take advantage of this situation to exploit them. Based on the FGDs, it is estimated that informal settlement dwellers pay more than 60 % higher tariffs than their informal counterparts. This according to the discussants has brought untoward hardship and frustrations to them because their meagre savings are spent on electricity.

7. Discussion of findings

Access to reliable and sustainable energy is crucial to all as it is a key input to eradicating poverty and promoting the socio-economic development of a country. Access to energy has huge implications for the quality of life of citizens and significantly impacts poor urban communities and their environment. Despite being at the center of several SDGs, including those related to poverty reduction, gender equality, climate change and health improvement, several efforts to improve universal access to affordable, reliable, and sustainable energy especially informal settlements has been challenging. The lack of access to electricity in informal settlements denies people several opportunities, better incomes, education, and a decent standard of living. This study examined how three informal settlements in Ghana access electricity — a key factor in achieving SDG seven and the challenges.

The findings showed that most of the discussants used charcoal for cooking followed by firewood, gas stove (LPG), rice cooker, electric stove, kerosene, and plastic cast respectively. This finding mimics the national situation in Ghana as the 5th Ghana Living Standards Survey (GLSS 5) found that more than half of the households (54 %) use wood fuel as the main cooking fuel [35,41] while charcoal ranks second (31 %). It further found that, in urban areas, 53 % of households use charcoal for cooking. This has implications for informal settlements as wood fuel and charcoal can hurt their health.

Secondly, the finding showed that informal settlements have access to electricity except for a few individual households who cannot afford the cost involved in accessing electricity. Indeed, this finding is similar to that of the [8,35] which indicates that 88.2 % of informal settlements have access to electricity. Whereas everyone can access electricity, there are certain procedures and documentation such as land title, site plan, and building permit. Unfortunately, informal settlement dwellers find it difficult to follow the bureaucratic procedure and provide the required documentation. Since electricity is essential, informal settlement dwellers find a way of accessing electricity. As noted by the concept of tactical urbanism, informal settlement dwellers on daily basis find innovative ways to respond to their needs if they are not provided by the state [26].

Typically, informal settlement dwellers connive with electricity officials and middlemen by paying bribes to get electricity connected to their homes. Hence, the findings uncovered that access to electricity in informal settlements is fraught with corruption leading to a high cost of connecting electricity. Apart from corrupting electricity officials and using middlemen to access electricity, others connect illegally while some tap electricity from nearby houses. Previous research indicates that as of 2007, 54 % of households within the AMA acquired their electricity through illegal means [35]. Recent research showed the situation has worsened to the extent that 75 % of informal settlement residents connected electricity illegally [19].

Thirdly, the cost of connecting electricity in informal settlements is very high and could get to as much as 500 % of the original cost of connection. This cost is a result of paying corrupt officials or middlemen, illegal meter acquisition and buying of electricity poles and power cables where the distance from an existing home is far. All these make the cost of connecting electricity eventually higher for informal settlement dwellers than those in formal residential areas. Related to this is the cost of electricity tariffs and rates which are seemly higher for informal settlement dwellers. This is caused by several factors including tapping electricity from other homes so the owner of the electricity meter decides on how much people who connect should pay or direct connection of electricity to households with meters by middlemen or electricity officials who then pay fixed tariffs regardless of their consumption. Whereas previous studies [10,12] have found informal settlement dwellers spend 30 % of their income on energy, this study shows that the situation in the three studied informal settlements in Ghana is worsening.

Again, in some cases, the number of people connected to one electricity meter is so many to the extent that the consumption goes beyond the range of residential meters leading to higher electricity tariffs. Indeed, it is estimated from the findings that informal settlement dwellers pay 60 % higher than their colleagues in formal residential areas. This supports the view that low-income households who obtain electricity through shared electricity meters can be charged higher rates because of rising block tariffs [47,48].

8. Recommendations

Based on the findings of the study, the following recommendations are made for policy and practice. First, informal settlements should be recognized as human settlements which deserve to be provided with electricity and electricity meters should be made readily available, accessible, and affordable to them. Where there are no electricity poles, they should be provided without additional cost to electricity seekers. This will encourage many people to apply for electricity meters and thus reduce not only the cost of connecting electricity but also the cost of electricity tariffs.

Second, in 2005 the ECG introduced pre-paid electricity meters to deal with the issue of energy losses and improve their revenue generation. However, these pre-paid meters are not favourable to informal settlement dwellers as most of them cannot pay upfront to use electricity. Therefore, there is a need to consider the use of post-paid meters for informal settlement dwellers. This will at least guarantee them a continuous supply of power as they do payments in instalments. This will help curtail and prevent problems with illegal connections, power theft, fire outbreak, electrocution, and reduction of stress among

informal settlement dwellers.

Third, whereas electricity is accessible to informal settlement dwellers, they must show evidence of land title, site plan and building permit which automatically deny them access to electricity and therefore must find alternative ways of accessing electricity. It is crucial to relax these requirements for informal settlement dwellers to have full access to electricity. In any case, informal settlement dwellers will find a way to access electricity and, in most cases, illegally, making the electricity provider lose revenue. Once informal settlement dwellers are ready to pay for the electricity, they should be allowed access to electricity without insisting strictly on the land title, site plan and building permit requirements.

Finally, there is a need to explore other sources of energy for informal settlement dwellers and not only rely on electricity. Since informal settlement dwellers are very low-income earners, other cheap sources of energy can serve their needs better. There are a lot of off-grade options available that could be explored for the benefit of informal settlement dwellers. A typical one which could be explored is waste to energy, as a lot of waste is generated in the informal settlements. For instance, one of the studied communities indicated that they are exploring innovative ways by which waste produced in the settlement can be converted into biogas. Similarly, solar energy could be explored to help power informal settlements to have sustainable and reliable energy to improve their living conditions.

9. Conclusion

The imbalances existing between formal and informal settlements regarding access to the electricity supply are well-acknowledged in literature. Despite the wide recognition that energy and electricity access is a prerequisite for sustainable development, disparities and wide gaps continue to exist between urban and rural and formal and informal settlements. The overall objective of this paper was to examine electricity access and challenges to informal settlement dwellers. Using three focus group discussions of 30 informal settlement dwellers in three communities in Accra, the findings showed that most informal settlement dwellers used charcoal for cooking followed by firewood, gas stove (LPG), rice cooker, electric stove, kerosene and plastic cast respectively.

Due to the bureaucratic procedure and documentation requirements, access to electricity in informal settlements is fraught with corruption leading to a high cost of connecting electricity. The cost of connecting electricity in informal settlements is very high and could get to as much as 500 % of the original cost of the connection while it was estimated that informal settlement dwellers pay electricity tariffs as much as 60 % higher than their colleagues in formal residential areas. Appropriate measures should be pursued to ensure that informal settlement dwellers have reliable and sustainable access to electricity to improve their standard of living and the achievement of SDG seven.

Declaration of competing interest

The author declared no potential conflicts of interest with respect to the research, authorship, and that this paper is not under review in any journal.

Data availability

The authors do not have permission to share data.

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