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The empirical reality & sustainable management failures of renewable energy projects in Sub-Saharan Africa (part 1 of 2)

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ABSTRACT

The future of electrification of Africa lies within off-grid generation via renewable energy (RE). Although many RE projects have started across the Sub-Sahara, especially public projects are seldom successful. This study engages directly (ethnographically) with the local communities benefitting or expected to benefit from the projects, the implementing organizations and government.

Despite the differences in culture and understanding, the reasons for failure of the projects are found to be similar across the different countries: (i) political agenda, (ii) process of awarding projects, (iii) stakeholder co-operation, (iv) planning & implementation, (v) maintenance and (vi) public acceptance & inclusion.

1. Introduction

One of the reasons for the deteriorating nature of publicly funded renewable energy (RE) projects in Sub-Saharan Africa (SSA) is the absence of a sustainable management method and more specifically, the inability to appropriately trace the designation of responsibilities. It is without doubt that publicly funded projects require dedication, planning and a transparent partnership with the implementing organization. Nonetheless, the sustainable management of these projects is commonly exasperating for the stakeholders involved in the project because the aim of implementation and responsibilities are not distinctly clarified. Consequently, it makes the projects multitudinously uncertain to manage effectively within Sub-Saharan Africa.

Generally, publicly funded projects possess characteristics such as prolonged durations, substantial budgets, multiple stakeholders and apprehension which are difficult to model, implement and manage effectively [1]. It is important to indicate the differences in objectives of privately-funded projects and publicly-funded projects. Oftentimes, privately funded projects are mainly focused on the objective of maximizing profits, return on investments and minimizing losses. Publicly funded projects are "thought" to have multiple objectives within the development of social values and provision of basic necessities within the concept of fundamental human rights.[1] It is expected that private organizations that invest in renewable energy projects in SSA, will execute a suitable management method in order to maximize their corresponding profit and return on investment. Hence, it is important to note that this study focuses mainly on publicly funded projects and, to partial extent, on projects founded on public-private partnership within the renewable energy field. Although a public-private partnership is considered beneficial to the provision of better public services via innovation and technology, this is not usually the case in "actual" renewable energy projects in SSA. The reason for a partial focus on public-private partnership (PPP) is that a clear path to the agreement within the PPP is not usually provided and as such, private organizations that participate in PPPs focus on acquiring a return on their investment even prior to the commencement of the project by bloating the total cost of the project.

In a study done on RE in Nigeria and Ghana, it was found that "So many projects fail because, when we talk about solar parks in Africa, most of the time people think this is just about finding an empty plot of land and implementing a project" [2]. Clearly, little thought is given to how projects will be managed once they are established, which largely contributes to their failure. In many

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[1] This is the expected situation but in most cases differs from expectation.

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countries within West Africa for example, many small and medium-sized photovoltaic (PV) projects have been implemented, ranging from solar boreholes to lighting thousands of street lights and powering the emergency department of hospitals. However, despite the potential of these projects, most of them have been left to deteriorate with no maintenance, no cleaning, no repairs and more importantly no sustainable management method that encompasses them all. Some of these projects are precipitously discontinued during planning and sometimes during implementation leading to the dissipation of limited resources such as funding and time. This situation has created a negative attitude towards the acceptance of sustainable and clean energy usage within the minds of the masses making it difficult for governments of these developing countries to adopt RE technology. Because most public projects are funded from taxpayers' money, these projects are frequently reviewed [3]. However, within developing countries in Africa, more often than not, these scrutinies do not provide solutions to the existing problem of sustainably managing RE projects.

Multiple studies have been conducted on the different aspects of managing public projects within different sectors of the economies in Sub-Saharan Africa. Nonetheless, some of these studies [4–6] are more in a generic form covering the entire aspect of project management within specific countries in SSA. This research differentiates itself from other studies carried out on the management of projects by pitting a direct focus on renewable energy in Sub-Saharan Africa. Our study investigates the failures of past projects in SSA by analyzing the linkages within the overall system encompassing the implementing government, the organization implementing the projects and more importantly, the public expected to benefit from the implementation of the project. By investigating the connections and the responsibilities of each stakeholder defined within the system, this research presents several points that require concentration to effectively manage publicly implemented RE projects. Understanding the principal concept provided in this paper of the overall system from project awarding to its implementation and finally to its sustainable management will enhance the sustainability of future projects and will provide the governments awarding the projects with methods on managing such projects. In addition, this study focuses mainly on publicly funded projects whilst partially focusing on public-private partnership as earlier indicated. Generically, this research aims to provide applicable solutions to the management of RE projects in Sub-Saharan Africa so as to enhance its sustainable development and technological acceptance.

The rest of this paper is outlined as follows. In Section 2 we describe related work from literature. In Section 3 we analyze the current state of affairs. In Section 4 we present our findings and conclusion.

2. Related work & literature review

This section presents an overview of the literature related to the management of RE projects in SSA. In Section 2.1 we describe the characteristics of public, private and public-private RE projects. In the remainder of this section (as well as the paper) we focus on public projects. Section 2.2 illustrates failures of these as reported in literature. In Section 2.3 we outline the challenges involved with public RE projects in SSA. In line with that, Section 2.4 describes the intricate problem of designating responsibilities within RE projects. Finally, Section 2.5 outlines our focus on 'Sustainable Management' as a way to secure RE projects in SSA.

2.1. The public-private mix of renewable energy projects in SSA

Renewable energy development is a crucial part of the way forward in sustainable development. For reasons transcending economic benefits, both the public and private sectors are assiduously engaged in developing the technological systems, governance frameworks, project management, monitoring and evaluation methods that are necessary for developing the renewable energy sector. For example, the *public sector* – which comprises government institutions, agencies and professionals – is known to invest largely in research and development of renewable energy systems, offering incentives and favorable policies such as tax exemptions for the development of the renewable energy sector [7,8]. As a result, governments, international organizations, universities and other research institutions are actively involved in and, in most cases, at the forefront of renewable energy innovation and development [9,10]. The leadership role assumed by public organizations in stimulating the development of renewable energy also reinforces the ethical underpinnings of renewable energy development. Hence, in the public sector, social and environmental benefits are elevated above economic reasons within the framework of the three core aspects of sustainability [11,12].

Notably, the adoption and use of renewable energy technologies is more widespread among *private* organizations and individuals in SSA countries. Solar power generation units, smart grid systems, among others are mainly used in homes and private establishments [13,14]. Also, although the initial investment in renewable energy technology is high, their long time benefits are known to outweigh high initial costs [10]. Furthermore, the future of energy consumption is forecasted to be mostly renewable and many governments, private organizations and companies are strategically transitioning their policies, and business models along this new paradigm. Consequently, more private organizations and investors continue to join the bandwagon for sustainable development by committing their resources to developing renewable energy technologies for commercialization. Therefore, the broader picture of renewable energy development depicts a mix of both public and private initiatives.

The *mix of public and private initiatives* is even more profound in developed countries where public-private partnerships have emerged as a model for designing, implementing and monitoring renewable energy projects [15]. Interestingly, these developed countries are mainly capitalist and liberal economies. As such, the hand of the government is hardly directly involved in the actual management of renewable energy projects. Largely, the public sector's role rests on provision of funding, regulatory mechanisms, demanding accountability, promoting fair competition and transparency [16]. These practices in developed countries are often put forward as exemplary models for developing nations to emulate. Sadly, the application and performance of such 'developed country models' are no less than fatal in developing countries.

Here, we attempt to decouple public RE projects from private RE projects mainly because of the unfortunate reputation that public RE projects have earned over their failure largely due to inefficiency and ineffectiveness in management. In addition, we consider the difference in the management of RE projects and the public and private sectors in SSA countries where public RE projects have a higher rate of failure. Hence, the remainder of this section focuses only on public RE projects in SSA.

2.2. Failure of public RE projects in SSA

Public projects in SSA countries generally come with high expectations and a lot of hype [17]. With regards to expectations, public RE projects are often designed to provide solutions to problems that confront the general public. Thus, the initiation of numerous RE projects comes with expectations to provide people with access to electricity to power their homes, hospitals,

streetlights and other energy-dependent facilities. In most cases, these expectations are shared by both the implementing agencies (government) and beneficiaries (people). On the other hand, hype often follows these expectations. In SSA, the media is very quick to disseminate information on public RE projects. Also, politicians, administrators and other bureaucrats involved in public RE projects are interested in claiming credit for initiating the projects. These levels of hype and expectation are not peculiar to SSA countries but common to countries around the world [17–19]. However, the experiences and performance of RE projects after the hype and expectation differ from country to country.

Within SSA countries, we identify five basic kinds of RE project failures: (i) shelved RE projects; (ii) stalled RE projects; (iii) appropriated RE projects; (iv) malfunctioning RE projects; and (v) nonfunctioning RE projects.

Shelved RE projects, as the name suggests, are those projects that have been planned but not implemented. Some RE projects are painstakingly planned and intensely hyped but never get implemented. An example is the so-called largest solar project in Africa to be implemented in Ghana [20] which, until now, is still yet to take off, if not already abandoned. There are also those projects (*stalled projects*) which although take-off, get stalled and never reach completion. For these kinds of failed projects, implementation is incomplete. Furthermore, some RE projects get appropriated (*appropriated projects*) in such a way that their implementation succeeds but deviates from the original plans and intents. Most appropriated projects come by due to imminent threats of failure that planned projects experience. Hence, they usually take on a scale smaller than the original project. Other appropriated projects may result from lack of appropriate technology for original projects. *Malfunctioning* projects are those projects that have already been implemented but are defective. This may result from either technical or non-technical factors. RE projects may malfunction due to technical breakdowns or due to turbulent socio-economic circumstances in their context that affect their proper functioning. Malfunctioning projects are those that are not completely broken down but only function on irregular basis. Finally, *nonfunctioning projects* are broken down and cease to be of any use. This is rather common in SSA countries. For example, it is not uncommon to see solar systems installed but not functioning [21,22]. Reasons for failure of RE projects in SSA are diverse. In addition, a multitude of factors can combine to result in a project's failure. Nevertheless, many of the causes of RE project failures lie in project management processes and practices. Different challenges emerge at different stages of the project management process that contribute to RE project failures. Below, we discuss a number of challenges – incompetence of project managers, stakeholder dynamics and designation of responsibilities – with special focus on poor designation of responsibilities (or lack of traceability in order words).

2.3. Public RE projects management challenges in SSA

One of the major problems that affect the effective and efficient implementation of public projects in some SSA countries is incompetence of project managers [6,4]. Project managers are not adequately equipped with the comprehensive skill set and competence to allow them to see projects through to the end with success. The project managers sampled display varying levels of competence in the various project management skills. Stakeholder management is considered a critical aspect of project implementation which has a significant impact on the success or failure of public projects. The members of society are usually the major stakeholders in most public projects. As a result, different approaches and strategies take into account the social costs and benefits of public projects as well as the level of engagement of the public in public projects. For example, the Social Discount Rate [23] is an approach for conducting cost-benefit analysis of projects. Also, community engagement methods have been used to ensure that members of communities participate in public RE projects [24].

When it comes to public RE projects in SSA countries, some of these community engagement methods are applied. However, engagement is often limited to the acquisition of land for the project, assembling people for the often festive inaugurating or commissioning of projects. Rarely do project managers handover ownership and management responsibilities to the public. As a result, some communities neither assume any responsibility for the functioning of the project nor see themselves as significant players in the projects' successes or failures. As such, they assume a neutral position when it comes to project monitoring. But such neutrality usually transforms to opposition in some cases as some reports have pointed to the public acting as saboteurs to the success of some RE projects in SSA [25]. The news article outlined the contradictions in the implementation and management of renewable energy projects by contrasting the case of a failed project implemented and managed by government with that of a successful government-funded but privately implemented project. Opaque bureaucracies, lack of a sustainability plan, sabotage, are some of the reasons contributing to failure.

It is common in some SSA countries to delegate project management responsibilities to local oversight or monitoring agencies such as district or regional monitoring offices. The problem with this form of delegation is that it diffuses the actual responsibility for managing the project among stakeholders who consider themselves as passive participants of the projects. This is because some of the agencies' oversight duties cover all active projects within their jurisdiction. The forgoing shows that the designation of responsibilities for managing RE projects gets murky when it comes to public RE projects. We consider this a key challenge in most SSA countries. We therefore commit the next section to exploring available knowledge on the challenges that RE projects within the public domain face because of poor designation of responsibilities.

2.4. The problem of designation of responsibilities

Within the stated scope of our research, there are no existing peer-reviewed publications that explore, in particular, the impact of lack of proper designation of responsibilities on the performance of renewable energy projects in SSA. Nevertheless, there are a number of fragmented sources of literature that identify the inability to trace responsibilities as a major cause of failure of public renewable energy projects. Most public projects in SSA are implemented without a clear structure or unambiguous structuring of relationships among stakeholders. As a result, key factors such as maintenance, protection of project infrastructure and functioning are not clearly allocated. Hence, loafing is common among stakeholders (ownership), as it is not clear who is responsible.

The lack of clear designation of responsibilities makes it impossible for RE projects to be supervised and continuously maintained. In addition, it complicates the process of tracing to the exact person who can be held responsible in case projects fail. Moreover, it leads to problems with ownership. For most public RE projects, it is not clear whether the projects belong to the government or to the people. Hence, needed management frameworks and local management systems cannot be actively sought in most cases. These problems make public RE projects vulnerable to contested ownership among interest groups, political manipulation by politicians, and outright ignorance by members of the public and

other stakeholders. We further note that the challenges faced by improper designation of responsibilities, and for that matter traceability, link with the lack of transparency in project design and implementation, inadequate project management competence, lack of explicit commitment to sustainable management, and the hasty co-optation of PPPs. Some researchers have suggested that these factors are common within public sector management practices [23], and in some cases intentional acts by officials to cover up financial malfeasance [26,27].

The next section outlines our focus on 'Sustainable Management' as a way forward in securing RE projects in SSA against failure.

2.5. Sustainable management

Our literature review identified a likely ambiguity in the use of the term 'sustainable management' of renewable energy projects. This is due to the plethora of literature that focuses on the technical strategies used in optimizing the efficiency and effectiveness of renewable energy technologies. Let us make a distinction between technical infrastructural management" and "administrative-bureaucratic management" in RE projects. Technical-infrastructural management entails technology optimization techniques whilst administrative-bureaucratic management entails the largely non-technical management process in RE projects. These two categories are equally important in managing RE projects. Yet, more existing research is focused on technical aspects to the detriment of non-technical aspects [28]. Hence, our research focuses on identifying the 'administrative-bureaucratic management' aspects of RE projects which can foster sustainable management of public RE projects.

3. Analysis of the current state of affairs

In this section, we present an overall analysis on the current state of affairs. We begin by restating the main objective of the research in Section 3.1. Next, Section 3.2 presents our research method. In Section 3.3 we outline our analysis of collected data and interviews. Section 3.4 presents the current state of affairs of the projects analyzed.

3.1. Objective of the research

The goal of this research is to develop a management method that is sustainable to manage renewable energy projects within Sub-Saharan Africa. This study investigates the failures of past projects by analyzing the structure of the overall project experience utilizing a strategy of "tell it how it is". In addition, this study proposes several points to effectively manage publicly implemented RE projects. To the best of our knowledge this is the first scholarly article that focuses on developing a sustainable management method for renewable energy projects in Sub-Saharan Africa. It also presents conditions for future studies and provides applicable solutions towards the problem of managing implemented projects.

3.2. Research method

This research uses an *ethnographic* approach in the sense that we physically observe (and interview) the stakeholders (governmental and local). Moreover, we visually inspect the installations involved (cf Table 1). This allows us to focus on the nature and interaction of particular social phenomena rather than testing hypotheses about them. As described in the subsequent section data obtained this way is often unstructured. It has not been coded at the point of collection along a pre-defined set of analytic categories. Analysis of this data involves explicit interpretation of the meanings and functions of human actions, the product of which mainly takes the form of verbal descriptions and explanations, with quantification and statistical analysis playing a subordinate role at most [29].

3.3. Research data analysis

In this study, available data on 29 publicly funded projects from ten countries was collected and analyzed thoroughly. The data was collected from countries within the Sub-Saharan region of Africa. The countries include: Nigeria, Ghana, Kenya, Gabon, South Africa, Tanzania, Mozambique, Ethiopia, Malawi and Uganda. Data from projects in Uganda was not compiled due to the political unrest happening at the time of the study. The projects analyzed in this report have been randomly selected based on their familiarity and visibility to the locals. Due to the limited openness of government officials and lack of information within most of these countries, data collected is not differentiated into multiple classifications. Furthermore, given that the hype presented towards the implementation of renewable energy projects is far below actual implementation, it is necessary to treat each project differently rather than classify them into categories and later combine corresponding responses. The types of projects recorded are micro-grid rural electrification, street lights, city electrification, electrification of public institutions such as: health care centers, public schools and government offices. To obtain a general and an unbiased perspective of the implemented projects, interviews were carried out with the locals benefitting (or expected to benefit) from the project, "some" project developers/implementers and "willing" government personnel. The states of the projects are analyzed based on physical evidence and interviews with the beneficiaries due to the absence of audit reports. In this way, the collected information is authentic and unbiased.

Furthermore, to accurately analyze the compiled information, we utilized a template that encompasses information such as country, project type, project expectations and project predicament. Information on project costs, implementing organizations and exact project location has been omitted from this paper so as to avoid any future ramification on government personnel or implementing organizations that have participated in the provision of data for this study. For each project we analyzed the data collected by the research team and identified corresponding characteristics between each of the projects such as expected goals of the project and their perspective on the causes of failures if applicable.

As earlier indicated, the projects analyzed in this study have been accumulated from different countries. Ten of the projects have been executed in Nigeria, four in Ghana, three in Kenya, two in Gabon, one in South Africa, two in Tanzania, two in Mozambique, three in Ethiopia and two in Malawi. These projects have also been implemented within different infrastructures and by different Local Governments within the respected countries. Ten of the projects constitute the lighting up of streets within the community with at least 30 street lights to 100 street lights. Two of the projects were implemented to power up a local hospital. One of the projects was implemented to power up a local school. Three of the projects have been implemented to power up public offices. Nine of the projects have been implemented to electrify public infrastructures such as water borehole to provide clean drinking water to communities, powering of security traffic cameras, water heaters in government housing projects and minor local connections. Finally, four of the projects were implemented in remote villages without access to the grid (**see** Table 1**: Project & Data Information**).

Table 1
Project & data information.

Project number	Project location	Project type	Physical analysis	Method	Timeline
N1	Nigeria	Street Light	Yes	II, FI, GD	December 2015–January 2016
N2	Nigeria	Public Hospital	Yes	FI, TC	February & March 2016
N3	Nigeria	Public Office	Yes	FI	March 2016
N4	Nigeria	Street Light	Yes	II, GD	December 2015–January 2016
N5	Nigeria	Street Light	Yes	II	December 2015–January 2016
N6	Nigeria	Public School	Yes	II, GD	January 2016
N7	Nigeria	Public Infrastructure	Yes	II, FI	January 2016
N8	Nigeria	Public Infrastructure	Yes	FI, TC	March 2016
N9	Nigeria	Street Light	Yes	II, GD	December 2015–January 2016
N10	Nigeria	Public Hospital	Yes	II, FI, GD	February & March 2016
G1	Ghana	Public Office	Yes	FI	February 2016
G2	Ghana	Street Light	Yes	FI, GD	March 2016
G3	Ghana	Remote Village Off-Grid	Yes	II, GD	December 2015–January 2016
G4	Ghana	Public Infrastructure	Yes	II, TC	March 2016
K1	Kenya	Remote Village Off-Grid	Yes	II, FI, GD	March 2016
K2	Kenya	Public Infrastructure	Yes	FI, GD	February & March 2016
K3	Kenya	Street Light	Yes	GD	March & April 2016
GA1	Gabon	Street Light	Yes	II, GD	February & March 2016
GA2	Gabon	Public Office	Yes	FI, TC	February & March 2016
S1	South Africa	Public Infrastructure	Yes	FI	December 2015
T1	Tanzania	Remote Village Off-Grid	Yes	II, GD	January 2016
T2	Tanzania	Public Infrastructure	Yes	FI, GD	January 2016
M1	Mozambique	Public Infrastructure	Yes	II, FI, TC	March & April 2016
M2	Mozambique	Street Light	Yes	TC, GD	April 2016
E1	Ethiopia	Public Infrastructure	Yes	II, FI	February–April 2016
E2	Ethiopia	Public Infrastructure	Yes	II, GD, TC	February–April 2016
E3	Ethiopia	Street Light	Yes	TC, GD	February–April 2016
MA1	Malawi	Street Light	Yes	TC, GD	March 2016
MA2	Malawi	Remote Village Off-Grid	Yes	II, TC	March 2016

Key

Public infrastructure	Methods	Code
Borehole	Informal Interviews	II
Water Heater	Formal Interviews	FI
Minor Connections	Telephone Conversation	TC
	Group Dialogue	GD

3.4. State of affairs of the analyzed projects

Of the 29 projects studied in this research, 26 possess a predicament that has somewhat been attributed to them, ranging from low maintenance to total failure and sabotage. The remaining three projects have only been recently implemented prior to the execution of this research and as such focus is placed only on the planning of those projects and their expectations. Although the projects discussed in this study remain anonymous, some of the projects already gained media coverage and scrutiny. The physical deterioration of these projects is easily comprehensible and visible to the naked eyes. However, the aim of this study is to understand the reasons for these failures and to provide sustainable management methods to curb the failures. Therefore, we combine the interview responses collected into three different categories: (i) local benefitting recipients, (ii) "some" developers/implementers of the project and (iii) "willing" government personnel. This is done to distinctly comprehend the issues affecting the success of renewable energy projects.

3.4.1. Local benefitting recipients

In this section, the responses collected from interviews and dialogues with the locals benefitting from the project are compiled and analyzed. Two sets of interviews with the locals benefitting from implemented projects were carried out. One based on a one-on-one interview and the other based on a dialogue involving multiple groups within a tightly knitted community. The most recurring issue from dialoguing with the locals is the aspect of public acceptance, sabotage and the maintenance of the project after its implementation. Responses focusing on 17 of the projects indicated that after six months of implementation the projects ceased to function whilst nine of the projects lasted less than three months. A disturbing response provided by one of the locals indicated that, although crime is known to be rampant within their region and the solar street lights and security camera that was implemented to curb the situation has broken down, yet for over three years nothing has been done towards its maintenance and repairs. 92% of the responses compiled from 26 out of the 29 projects complained heavily about not receiving any responses and sometimes responses coming after as long as six months after complaints of failures have been lodged with the respective local government. Other issues presented by the locals indicated that since these projects are implemented by either the local or state government from a specific cluster, indigenes from other clusters sabotage these projects, envious of the fact the project has not been implemented within their local government. This makes the absence of securing these projects one of the many local reasons for their failures. In a discussion with competent solar technicians who reside within these communities, an indication was made that maintenance was the main problem attributed to the projects' failure. However, a clear path to understanding the institution responsible for the maintenance of the project doesn't exist. In addition, public acceptance of the technology also affects the whole system. When the implementing organization does not clearly explain the system to the locals, then people tend to overload the system or utilize in ways that are not advisable.

Some other project failures [25] focused on the perspective of the locals not included in this study. These projects possess similar traits

to the responses provided. One project was implemented approximately five years ago with the goal of electrifying water borehole pumps, fish driers and street light, providing the community with access to drinking water, securing their streets at night and positively improving the local fishing economy. However, three months into its operation it ceased to function and all failure reports sent to the authorities were never acknowledged after an initial repair session on faulty cables was carried out. This process has caused a domino effect in such a way that it has tainted the effectiveness of the technology and its acceptance. Several state governments have renounced all renewable energy projects to focus on grid connection, a situation that could take more than a century to accomplish.

3.4.2. Project developers & implementers

Responses were compiled from an interview with 15 project directors that have to some extent controlled or managed the implementation of these projects. As noted earlier, "some" developers/implementers. The "some" has been highlighted to indicate that of the 29 projects indicated in this study only 15 of the implementing organization personnel agreed to participate in this study. All interactions in this section were carried out on a one-on-one basis. Of the 15 interviews 33% of the respondents indicated that the project was outsourced to them by a different organization, 53% claimed to have been awarded the project via the public tendering process and 13% preferred to avoid the question. It is imperative to note – that not having the full co-operation of the awarding local governments – it is difficult to ascertain what the original values may present when all awarded projects are analyzed per country. These values are only based on the responses provided by the implementing project organizations in this context.

Although some project directors were cautious and conservative in providing the implementation and maintenance plan, some others were profound and open-minded with such information. It was gathered that at most times no preliminary studies were carried out. Instead utilizing the assumption that wherever the sun shines, solar energy could be harnessed and thus missing out on very important information that affects the sustainability of the system in general. Discussing about the management of the system, all various participating project directors indicated that indeed there is at most times no clear planning with respect to that, whilst some indicated that it is the responsibility of the awarding local government to deal with the management and maintenance of the system. However, in instances of a PPP, the implementing organization is usually responsible for the management of the system. Nonetheless, funding for its maintenance is where misunderstanding arises from as the implementing organization claims the government should be responsible for that whilst the awarding government indicates the opposite. This clearly shows that situations of this case arise only when inadequate planning occurs. One fact presented by one of the project directors indicated that there is usually no cooperation in terms of understanding the technology better with the benefitting community and as such problems are bound to arise when systems are overloaded or mismanaged by the local community themselves.

In a study on the major reason for failure of most solar street lighting projects in Nigeria [30], it was indicated that most of these projects fail due to system sizing whereby the output of the panels fail to match the battery size for effective charging, therefore causing the battery to deteriorate within a couple of months. In some cases, the opposite was recorded, where the load of the batteries was higher than their output capacity. It is evidently clear from the dialogue that most of the implementing organizations studied in this report are mainly focused on the profit of the business and in turn losing sight of the sustainability of the system and its effect on the future generation to adopt the technology.

3.4.3. Government personnel

Several studies, papers and news reports [31–35] have reported on the corrupt nature of the process of awarding projects in SSA countries with audit reports presenting findings that do not exist so as for political parties to implement their specific agenda. Given the evidence of rampant corruption in Africa [36], it is not difficult to ascertain to what extent corruption infiltrates the process of how projects are awarded to implementing organizations. However, in this case we approached the dialogue with a blank frame of mind. In an attempt to extract direct answers on the existence of corruption in awarding projects with the participating personnel, neither was there a direct response nor indirect response provided. Towards the aspect of the maintenance and management of renewable energy projects, some of the participants made it clear that inadequate planning was the main issue that affects the sustainability of the projects and the process in which projects are awarded doesn't necessarily affect the implementation of the project.

Some of the participants during the interview also indicated that due to the failures of these projects, their respective governments have decided to focus on electrifying communities and local infrastructures via the grid connection. Although having in mind that this process might take a very long time to complete and will require billions in financing, they state that it is the main option. However, we believe that this is part of the hidden politically driven agenda that includes limiting the use of renewable energy to support the organization of lobbyist as a favor for their support of the government. The absence of a clear responsibility of participating stakeholders is one that plagues the control and management of the projects, whilst the ethical responsibility of the government is lost in the process. This results in the loss of trust within the masses towards the government.

Deducing the responses gathered from our data collection and interviews with the relevant stakeholders for public projects in Sub-Saharan Africa, we are able to excerpt that the failures of renewable energy projects in SSA are linked to the political agenda of the government, the process of awarding projects, the participating stakeholders, inadequate planning and implementation, maintenance and management of implemented projects and finally, the public acceptance and sabotaging of the technology.

4. Findings and conclusions

The energy problems experienced in Sub-Saharan Africa today can only be solved by the decentralization of energy generation to the smallest subset possible. To achieve that, renewable energy must be considered and utilized. This supports the generation of clean energy and would contribute enormously to the "unofficial economy" that is the backbone of the Sub-Saharan economy. However, the reason of failures gathered from the survey, interviews and physical inspection of the projects should be taken seriously as this negatively influences the further dissemination of the technology. In part 2 of this study (Failures & Generic Recommendations Towards the Sustainable Management of Renewable Energy Projects in Sub-Saharan Africa), we further provide an in-depth analysis of the problem and subsequently provide recommendations that must be considered by implementing governments, organizations and locals expected to benefit from renewable energy projects in Sub-Saharan Africa.

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