The empirical failures of attaining the societal benefits of renewable energy development projects in Sub-Saharan Africa

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Abstract

The number of renewable energy (RE) projects that have been implemented in Sub-Saharan Africa (SSA) has soared over the past couple of years. The number of projects to be implemented within the coming years is expected to rise considerably. However, the societal benefits of RE projects implemented in SSA have not been studied thoroughly.

This study attempts to: (i) uncover the differences between the expected and the realized societal benefits of utilizing renewable energy technologies (RETs) in SSA, (ii) reveal any empirical failures in realizing those benefits and (iii) create awareness towards the sustainable implementation of RE projects. Within the realm of publicly-funded projects, we aim to provide solutions that assist these and future projects to meet their societal benefits. We investigate 29 projects that have been implemented in ten SSA countries taking into account direct experiences of the local users and project developers. We find that most of the projects investigated in this study have few to no societal benefits within a short period of time after the "cutting the ribbon" event. To counteract this, we present corresponding recommendations.

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1. Introduction

The consumption of energy globally has increased at a fast pace and this has mainly been attributed to the rate of growth in developing countries [29]. Still, there exists a high level of inequality around the world in the access to contemporary energy services [2]. Eradicating poverty in Sub-Saharan Africa (SSA) will require substantial growth and development within the economy. To achieve this, energy plays an important role. Constant energy supply is a problem in almost all African countries within the Sub-Sahara. An affordable and environmentally friendly way of generating energy is crucially important for sustainable economic growth and eradicate poverty. Nonetheless, the actual societal benefits of utilizing renewable energy (RE) infrastructures within the region of Sub-Saharan Africa are questionable in view of the considerable number of failed projects [16].

Energy (i.e., electricity generation) is considered as a basic enabler for a working economy. Discharge from fossil fuels is known to exceed both local and national levels, thereby negatively influencing the global habitat and contributing to changes in the climate [32]. Unfortunately, the poorest communities around the world who live in delicate and endangered locations are affected the most by changes such as drought, melting ice caps, and floods [27]. The risks faced by the people in such communities are frequently intensified by the unsustainable use of resources. Some of the potential benefits of utilizing RE are known to include its renewability, cleaner environment, economic benefits in terms of job creation, balanced pricing on energy utilized and its reliability [10]. Nevertheless, these technologies still face some problems with respect to their implementation, local acceptance and sustainable management [15].

Several studies have been presented on the potential and benefits of RE for Sub-Saharan Africa (SSA) [7, 10, 45]. However, there are still no clear policies to be implemented by most governments within developing countries. Substantial time is spent on discussions of policies, meetings and other arrangements whilst time is lost on the actual implementation of policies and renewable energy technologies (RETs). This often results in the prolongation and
in completion of projects. Utilization of RE provides an opportunity for developing countries in Sub-Saharan Africa to cross over directly into an environment of clean energy. Thereby, they may circumvent the problem of the restrictive head start that Europe is dealing with currently, possessing an existing grid and an existing energy production, which over time will be substituted for clean energy and is expected to require large amounts of financing. Developing countries could then utilize RE to satisfy their energy needs and wouldn’t require obsolete and polluting infrastructure [35].

Whilst there may exist common societal benefits for the usage of RE technologies, there still exists a sizeable difference in these so-called benefits from the perspective of developing countries in SSA as compared to for example, developed countries in the European Union. As for societal benefits from implementing RE projects in SSA, it is hard to make up an exhaustive list of what may be expected. Nevertheless, there are some benefits that readily come to mind. For ease of discussion, Table 1 defines and categorizes them.

A concrete example of societal benefits – consider a village in Nigeria without any street illumination. The village has a lively market which closes after dark. Suppose that an RE project is carried out resulting in a solar based street light system. As soon as the project is completed, market women can keep their booths open till far after dark. This generates more income. Also, criminality decreases. People leave their houses without fear and without risk of stumbling. In summary, this RE project enhances prosperity, safety and a sense of community. When – due to lack of maintenance - the street light system would cease to function, this potentially leads to loss of jobs, loss of finances due to all the domestic and productive appliances purchased when electricity was available, decommissioning of obsolete plants and the related environmental concerns etc. How such an RE project failure may disrupt the social, cultural and economic lifestyle of a community is presented in several studies [18,34]. Implementing RETs is one aspect of sustainable development, whereas attaining the social benefits of their implementation is another aspect. Although they are expected to be complementary of one another, this is not usually the case as projects that are implemented without adequate planning and a sustainable management method only lead to the provision of little or no benefits, thereby rendering the implemented project useless and a waste of taxpayers’ money [15].

This study attempts to: (i) uncover the difference between the expected and the realized societal benefits of utilizing RETs in SSA, (ii) reveal any empirical failures in realizing those benefits and (iii) create awareness towards the sustainable implementation of RE projects. To accomplish this, we investigate 29 projects that have been implemented in ten SSA countries. Let us note that [15] utilized these same projects in order to investigate the empirical reality and sustainable management failures of RE projects in SSA. The novelty of the current study lies in the fact that we analyze these 29 projects from another perspective: their actual societal benefits in comparison to the benefits that were expected. To the best of our knowledge, such a comparative study is new in literature. The same holds for the chosen method: we engage directly with both sides of the spectrum: (i) the benefitting society as well as (ii) the project developers. Our research further contributes to the intersection of RE benefits, sustainability and development in SSA, ideating and bridging the gap between research and reality, and opening up the possibility for further research within this realm.

The rest of this paper is structured as follows. In Section 2, we analyze the current state. Section 3 presents our dialogues, discussions and findings from implemented projects. Section 4 presents proposals for improvements. Finally, in Section 5 we present our conclusions.

### 2. Design of the current state analysis

#### 2.1. Research objective and methods

The main aim of the research is to deduce the yield benefits of utilizing RE in comparison to the expected societal benefits (as defined earlier) based on projects implemented in SSA. We analyze different publicly funded RE projects based on the benefits expected by the project recipients. To achieve this, the ethnographic approach is utilized. Ethnography 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 [3]. Specifically, we immerse ourselves in the situation as if we are locals. As such, we engage in a dialogue with participating stakeholders. Next to that, we carry out physical inspections on the projects presented in this study (Table 2). In our view, this a congruous approach to finding an equilibrium point between traditional scientific methods and an appreciation for the complex and multi-faceted context and way of life of the Sub-Saharan region [14]. In addition, one of the secondary aims of this research is to present the situation as is whilst maintaining acceptable scientific integrity. Ethnography presents that opportunity.

Some authors present ethnography as a complete...
methodological approach to research, whereas others present it as a technique for data collection in field research [6,12,22]. Consequently, it is possible to employ ethnography as a methodological framework which encompasses different research techniques and methods on the one hand, and using ethnography as a method for gathering data for analysis in a suitable research design on the other hand. Here, we address ethnography as a research approach in entirety and not merely as a data collection technique. The adoption of the ethnographic method in research does not only depend on the characteristics of the method itself, it is also contingent on the type of research being conducted. In the case of our study, the primary reason which justifies ethnography as a suitable method is that the type of research being undertaken is an action research involving field work. This requires direct interaction with, and observation of the people, their institutions, infrastructure and systems. The ethnographic method makes this possible in the ways elaborated below.

Core of ethnography is direct field work: Ethnography basically refers to field research and includes participant observation in most cases. In ethnography, researchers have the opportunity to immerse themselves in the context of the research with the goal to gain direct insight and experience of the subject matter [11]. As a result, researchers who are interested in understanding the nuances of an issue or getting a good grasp of the big picture adopt the ethnographic method.

Data collected is primary and qualitative: Primary and secondary data are the two basic types of data used in most studies. Primary data is known to possess originality mainly because it is first-hand data collected by the researcher [12,22]. Conversely, secondary data is already processed and interpreted and may not offer a true reflection of the current issue being investigated, as is the situation in SSA’s development. The direct observation does not only give the researcher a true experience of the situation being investigated, it also enhances the quality and representativeness of the data being collected. Ethnography does not solely lead to qualitative data mainly because researchers may also collect quantitative data in the course of an ethnographical study [25]. Through the ethnographic method, researchers are stimulated in understanding causes and effects, describing relationships, theorizing observations and making categorical assumptions or conclusions about factors that underlie a particular phenomenon.

Opportunities for validation: Collecting primary data alone may not satisfy the desire of many researchers to obtain valid information. One of the pronounced methods used to attain validity in research is triangulation [5,25]. Ethnography offers the opportunity to triangulate information obtained, thereby offering researchers a platform to verify and confirm information when in the field.

In addition to the points stated above, which already offer an idea about the strengths of the method, we further identify some specific factors we considered in applying this method to our study. The context of our study had a huge impact on the choice of research design. Although great differences exist in the cultures of the people of the countries within SSA, there is a high level of homogeneity in their RE records (which is the subject of our study). The ethnographical method allows an in-depth, descriptive and explanatory approach to be applied for empirical assessments of the factors causing the failures and sustainable management challenges of RE projects.

With respect to the objectives of study, part of the approach of the research was to solicit the expert views of project managers and other stakeholders in the RE sectors in SSA. This required direct engagement with them without electronic or print media. As a result, most of the respondents had the confidence to voice out their opinions on the reality of the situation and open up about issues which would have been ignored if other methods such as self-administered questionnaires were used to collect data. Our

| Project Number | Project Location | Project Typea | Physical Analysis | Methodb |
|----------------|-----------------|---------------|------------------|---------|
| N1             | Nigeria         | Street Light  | Yes              | II, FI, GD |
| N2             | Nigeria         | Public Hospital | Yes            | FI, TC  |
| N3             | Nigeria         | Public Office | Yes              | FI      |
| N4             | Nigeria         | Street Light  | Yes              | II, GD  |
| N5             | Nigeria         | Street Light  | Yes              | II      |
| N6             | Nigeria         | Public School | Yes              | II, GD  |
| N7             | Nigeria         | Public Infrastructure | Yes | FI, TC  |
| N8             | Nigeria         | Public Infrastructure | Yes | FI, TC  |
| N9             | Nigeria         | Street Light  | Yes              | II, GD  |
| N10            | Nigeria         | Public Hospital | Yes            | II, FI, GD |
| G1             | Ghana           | Public Office | Yes              | FI      |
| G2             | Ghana           | Street Light  | Yes              | FI, GD  |
| G3             | Ghana           | Remote Village Off-Grid | Yes | II, GD  |
| G4             | Ghana           | Public Infrastructure | Yes | II, TC  |
| K1             | Kenya           | Remote Village Off-Grid | Yes | II, FI, GD |
| K2             | Kenya           | Public Infrastructure | Yes | FI, GD  |
| K3             | Kenya           | Street Light  | Yes              | GD      |
| GA1            | Gabon           | Street Light  | Yes              | II, GD  |
| GA2            | Gabon           | Public Office | Yes              | FI, TC  |
| SI             | South Africa    | Public Infrastructure | Yes | FI      |
| T1             | Tanzania        | Remote Village Off-Grid | Yes | II, GD  |
| T2             | Tanzania        | Public Infrastructure | Yes | FI, GD  |
| M1             | Mozambique      | Public Infrastructure | Yes | II, FI, TC |
| M2             | Mozambique      | Street Light  | Yes              | TC, GD  |
| E1             | Ethiopia        | Public Infrastructure | Yes | II, FI  |
| E2             | Ethiopia        | Public Infrastructure | Yes | II, GD, TC |
| E3             | Ethiopia        | Street Light  | Yes              | TC, GD  |
| MA1            | Malawi          | Street Light  | Yes              | TC, GD  |
| MA2            | Malawi          | Remote Village Off-Grid | Yes | II, TC  |

a The project type public infrastructure includes all projects such as – solar powered boreholes, water heating connections and small scale micro grids.

b Methods include, II – Informal Interviews, FI – Formal Interviews, TC – Telephone Conversations, GD – Group Dialogues.
study also aimed to figure out the solutions to the problems with RE development projects. A direct engagement with stakeholders was the most appropriate way to arrive at both realistic and applicable solutions. Also, as researchers, we needed to confirm in person the state of the RE projects under study (cases of RE projects). Hence, direct observation was indispensable in ascertaining the true state of the projects within the corresponding countries in SSA.

It is paramount in research to precede empirical research with reviews of existing literature. In doing so in our study, we encountered different scenarios and concepts in the course of our literature studies which needed to be underpinned by empirical findings (underpinning concepts with empirical observations). Adopting the ethnographic method was essential because it enabled us to get a first-hand grasp of the issues and relate the concepts and ideas outlined in literature with actual observations in the field. Ethnography was the right conduit to give meaning to concepts. A typical ethnographic study requires that the researcher becomes part of - or attains proximity to - the society or group being studied [12]. Planned site visits were carried out to all corresponding RE projects for observation. The conduction of ethnographic interviews was executed as indicated within the corresponding sections. Implementing the ethnographic method can be enhanced when the researcher is already familiar with the research setting [11]. The researchers’ familiarity with the setting proved to be helpful in choosing locations of interest. The findings were validated by cross-checking the data gathered with relevant existing literature in some cases. Further cross-examinations were made with the findings of other studies.

2.2. Research data analysis

The results presented in this study are based on the empirical findings of post-implementation appraisal of 29 projects (see Table 1) in ten different Sub-Saharan African countries (Nigeria, Ghana, Kenya, Gabon, South Africa, Tanzania, Mozambique, Ethiopia, Malawi and Uganda). The types of projects investigated include: micro-grid rural electrification, street lights, city electrification and electrification of public institutions such as health care centers, public schools and government offices. Two methods were implemented in this study: (i) a semi-structured interview with project beneficiaries and project implementers and (ii) a physical inspection of the implemented project. It is imperative to note that [15] utilized the projects in this study to investigate the empirical reality and sustainable management failures of renewable energy projects in Sub-Saharan African countries. The current study looks at the same 29 projects from another perspective: the actual societal benefits of these RE projects in comparison to the benefits that were expected.

The benefits of the chosen method of analysis are its effectiveness to determine the societal benefits by engaging directly with the benefitting society and understanding the perspective and goal of the project developers. Moreover, a direct communication with project implementers is time-effective and builds a comprehensive idea of the local societal benefits of utilizing RE. All participants of the study were randomly selected and based on self-participation. To further accurately analyze the compiled information, a template was utilized that encompasses information such as country, project type and project goals and benefits. Information on the implementing organization, exact location of project and total project cost has been excluded due to a confidentiality clause and to avoid any future implication on project implementers that participated in the provision of data for this study. The data collected by the research team was analyzed and corresponding characteristics were identified, such as the expected benefits of the projects and the reasons projects fall short of attaining the expected benefits. Our steps towards attaining validity began with the commitment to obtaining credible data. We ensured that data was original and recounted to reflect respondents’ own expressions rather than a translation in the researcher’s own words. In order to avoid lacing observations with the researcher’s own biases, due diligence was followed and the observer’s notes were reviewed by colleagues involved in the study to certify the integrity of observations.

Furthermore, we triangulated the data obtained in the study. This was done by utilizing different methods of obtaining data, questioning and observations for all stakeholders over the multiple cases of RE projects involved in the study. We posed identical questions to participants from different countries in the Sub-Saharan region. The recurrence of issues raised cross-border instilled confidence that the findings are not merely aggregates of opinions but real issues confronting SSA.

2.3. State of affairs of the projects analyzed

Some of the projects presented in this study have already gained media attention and negative feedback due to the physical deterioration of the RE infrastructure implemented. Our study tries to emphatically comprehend the issues affecting those projects from attaining their expected benefits. The main aspects of the dialogue focused on data that is qualitative, such as local beneficiary satisfaction, expected benefits and actual benefits, stakeholder participation and community engagement. Furthermore, discussions on the implementing organizations focused on the organizational goals, specific project goals and expectations and the organizations’ expected benefit towards the local community benefitting from the project. A preliminary analysis of the projects indicated that three of the projects have recently been implemented. Of the 26 other projects, 17 of the projects ceased to operate after some months (ranging from three months to 18 months) after their implementation and commissioning, whilst the remainder of the projects remained partially operational and as such only met some to none of their expected goals.

3. Findings & discussions

This section presents further details about our interview protocols. Next to that it summarizes our findings. In Section 3.1 we focus on the direct beneficiaries of the 29 projects under consideration. Section 3.2 switches to the project developers. The project financiers are treated in Section 3.3. From the interviews and surveys with the participating stakeholders we distill in Section 3.4 the shortcomings on the proposed societal benefits. Finally, in Section 3.5 we present a short juxtaposition to other projects.

3.1. Project beneficiaries

Two sets of interviews with the local beneficiaries 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. Respondents were asked if they understood what the corresponding benefits of the technology implemented in their community are. Nearly 98% of the respondents had an idea of the expected primary benefit. However, given the educational level of the participants, it is understandable that the secondary benefits may not have been clearly understood. Further questioning on the operation of the implemented projects in the corresponding community provided mixed views. Questions were posed to participants about their support on RE projects (see Fig. 1). Of all the participants (a total of 138 individuals and 16 groups) connected to the 29 projects, 22% are willing and supportive, 28% do not support and 50% have no definite response.
Of the 28% that indicated that they do not support the RE development projects [see Fig. 2], 80% have encountered some failed projects and 20% indicated their uncertainty of the efficiency of these projects.

Furthering the dialogue into the direct and indirect impact that the implemented projects have provided, some respondents indicated grave anger at the government and the implementing organization. This is due to the fact that some of the projects failed to operate just within months of their commissioning and after all requests that were sent for maintenance nothing was done to rectify the problems. This has been the case in about 17 of the implemented projects. The doctors who participated in this study - rectify the problems. This has been the case in about 17 of the implemented projects. The doctors who participated in this study - in a remote village in one of the locations visited for the study, small solar panels have been implemented to charge torch lights and mobile phones. However, the participants from this village vented their anger at the local government because the products they were provided with according to them were “very useless” and they perceived that this was done so that the same people could be voted in office again and not because the local government cares about them. This is also a problem in some communities in other Sub-Saharan African countries. On the positive side, in two of the projects implemented to power boreholes and to provide water for the community, the status of these projects is regarded as operational because the benefit of the projects are being met according to the respondents from the communities. They appreciated being able to wash and to cook. Further questioning in this community indicated that the implementing organization involved the community fully into the project which contributed to further success in terms of management and maintenance. However, based on the overall responses received and analyzed in this study, the expected benefits from most of the projects are underachieved and this is attributable to multiple reasons.

3.2. Project developers

Responses were compiled from interviews with 15 project developers that have to some extent controlled or managed the implementation of the projects presented in this study. The interviews carried out with project developers were done on a face-to-face basis. In cases where physical interviews were not possible, telephonic conversation was executed. When asked about the social benefits of the implemented projects, project developers mentioned: electrifying the community, reducing theft, enhancing economic activities and reducing poverty, promoting educational activities, saving the environment etc. This however differs from the output benefit of the implemented projects investigated in this study. Directing the questions towards the physical status of the implemented projects, approximately 87% of the respondents blame the government stating that:

“They provide us projects to implement but when issues of funding arise, they present approximately 25% less than what is required for a sustainable project and even sometimes 40% less in some cases. How do they expect us to provide a sustainable project with that kind of attitude?”

Furthering the dialogue, the respondents indicated that the government is sometimes not really interested in the project and these projects are just done to fulfill the partial obligation of being in political office to be voted in again even though the projects may not be suitable for implementation. A similar response was presented by the project users as indicated earlier. Several papers have been published on these issues [26,39]. Although some project managers were cautious and conservative in providing implementation and maintenance plans, some others were profound and open-minded with such information. It was gathered that in some cases no preliminary studies were carried out. This was blamed on the budget provided by the implementing government. This causes the implementing organization to resort to utilizing the assumption that wherever the sun shines, solar energy could be harnessed and thus missing out on important information that affects the sustainability of the system to meet its expected benefits. In some locations where street lights and security cameras have been implemented, a physical inspection of the location provided an
example of failure due to system sizing. At one location the appropriate solar panels were not utilized and the corresponding connected battery system did not match the solar panel that was connected. This resulted in deterioration of the batteries and rendered the project useless. Questioning the project developer about this situation, the response was rather vague. This indicates that some of the projects that were investigated in this study were implemented by incompetent organizations, thus validating some of the comments of the locals who participated in this study. Discussing about the beneficial output being lower than expected, 11 of 15 project developers indicated that the problems with the system are sometimes two-fold: (i) the government and its method of funding projects and (ii) the public understanding and acceptance of the technology. However, it is quite eccentric that these project directors and managers fail to accept the responsibilities of the failed project. Nevertheless, the project developers that have recently implemented the latest projects indicated that they took into account adequate planning and integrating the community members into the project, thus making it a shared responsibility between the implementing organization and the community. A similar response came from the respondents from the community of the corresponding project.

From our dialogue, it is indicative that the reasons for these projects falling short and in some cases massively away from attaining their social benefits are attributed to their failures. These so called failures also indicate how participatory development is sometimes utilized as a superficial strategy and technical fix. Some studies have been presented on corresponding issues [9,20,21,38].

3.3. Project financiers

As several research papers have concluded, the access to modern energy in Sub-Saharan Africa is essential to the realistic sustainable development of the region. This includes meeting the Development Goals (DGs), reducing poverty and enhancing job creation. However, the finance required to achieve these aims and goals, when funded by the government within the corresponding countries, has some cynical scruple attributed to it.

Based on the extracts of the comments made by project developers, public project financiers (in this context also known as government institutions) provide funding for public projects at a rate less of what is required to execute a complete sustainable project, whilst incorporating expectations of the subpar project to operate at full capacity. This raises an important question towards the importance of the implemented project. Are the societal benefits of the projects important? Or is the visibility of the implemented project its sole importance? In Ref. [15,16]; the authors indicate on how government institutions run by politicians in SSA utilize the visibility (without any regards for sustainability) of implemented RE projects to further their own political party agendas, so as to be reelected to office. Most government officials who participated in one or more of the projects presented in this study, declined to have further dialogue with the researchers when the latter cited the physical state of some of the projects as “deteriorated”. Others who participated in providing more information about the process of project financing, indicated clearly about the transparency involved. However, when pressed on about the state of projects and shared responsibility, the dialogue is simply redirected, and blame is either pinned on the community where projects are implemented or the project developers involved.

From the analysis of the statements of project developers were presented on the aspect of only part-financing of the projects, government officials responded that due to reasons such as bureaucracy, project financing is not usually released on-time and in some cases, financing is provided to lobbyist organizations with no experience in the design and implementation of RE projects. Grounded on these actions, it becomes arduous for the financing institutions to enforce required litigations.

3.4. Shortcomings on the proposed societal benefits

To ascertain that our study is accurately triangulated, we followed up on our study by combining all the data from the interviews and surveys with all participating stakeholders of the 29 projects analyzed. Based on the findings of these activities, we further corroborated this information with the societal benefits as presented in Table 1, by carrying out an additional inspection and survey of the location. The participating stakeholders indicated based on their projects the expected as well as the realized benefits based on the current state of the projects. The data we accumulated has been clustered by project type based on the assumption that the expected benefits should be homogeneous even across borders. In a situation where a societal benefit (for example, SB2) is not selected by a specific project (for example, N4), whereas a different project (G2) under the same project type (in this case, street light) selects it, then the societal benefit SB2 is included in the expected benefit of that project type. However, for the aspect of the realized benefits we have clustered it based on the projects that are either partially functioning or recently implemented when the study commenced. The resulting investigation led to the findings of the realistic benefits as compared to the expected benefits presented in Table 3 and the corresponding status quo shown in Table 4.

Just as the computation of the expected benefits was based on all participating stakeholders, the realized benefits were computed on the response of the project beneficiaries. As can be seen, the realized benefits have also been presented per project. For example, for the project type of public infrastructure, the realized benefits are shown as SB7, SB9 and SB2. However, these realized benefits are not attributed to all the projects within this cluster. Rather, for the realized benefits SB7, only projects S1 and T2 have attained it. For benefit SB9, only projects G4 and T2 have attained it and so forth as can be seen for the rest of the projects. Further analysis of the responses and the projects indicates a vivid correlation to the agitation presented by the project beneficiaries during the initial discussions carried out. Whilst some of the projects analyzed in this study possess their own reasons for failing to realize the expected benefits, the ill-management and inadequate maintenance of implemented projects is pervasive amongst the main reasons for failures. Although most of the failures indicated in this paper are based on the physical state of the projects, the ultimate reason for failure could explicitly be the resultant of the political agenda, the inadequate tendering process, the non-existing stakeholder cooperation and non-inclusion of the project users from the onset to the commissioning. It is imperative as a potential finding of this study, that for the societal benefits to be achieved, beneficiaries and project users should be included in the project utilizing a bottom-up approach. Furthermore, project users cannot be held equally responsible for failures that arise from the top-down approach. Thus, it is objective to indicate that based on our dialogues and findings utilized in the projects we investigated, they possess only superficial inclusion of project users.

3.5. Juxtaposition to other energy projects

To commence, it is imperative to reiterate that our focus was not directly on the analysis of failed projects, but rather on randomly analyzing 29 projects of different applications and characteristics. The state of failure of these projects is merely coincidental. In this section, we present a comparative difference between the projects
analyzed in this study and the state of some other projects not analyzed.

Firstly, we look at projects within the same realm as those analyzed in this paper. For example [16], discuss the empirical failures of RE projects and the corresponding consequences from project inception until its implementation. These have been shown to proliferate corruption, thereby affecting the implementation of publicly funded RE projects. In the present paper, we corroborate these failures with each of the projects analyzed, presenting its unique reason for failure (as presented in Table 4: Attributed Failures & Status Quo). Our analysis and general findings point to the lack of accountability and transparency as the general consensus for preventing these projects from attaining the specified and/or expected benefits defined from the onset. Since these projects are publicly funded by the government, there are studies indicating that government implemented projects are more likely to fail than privately held projects [13]. The reasons are similar to those presented earlier from previous studies [24,37,47]. This paper intends in no way to convey the impression that all publicly funded RE projects in SSA are likely to fail. However, the fine line between the successes and failures (of public projects) is very thin and routinely revolves around a lack of accountability. Additionally, the likelihood of success is minimal for similar RE projects as those analyzed in this study that neglect the inclusion of local stakeholders. One predominant requirement is the clear differentiation of responsibilities of all participating stakeholders (even within the

| Project Type | Project No. | Expected Benefits | Realized Benefits |
|--------------|-------------|------------------|------------------|
| Street Light | N1, N4, N5, N9, G2 | SB1, SB2, SB8 | SB2 (M2, E3, MA2) |
| Street Light | K3, GA1, M2, E3, MA1 | All Projects Non-Functioning | |
| Remote Village Off-Grid | G3, K1, T1, MA2 | SB1, SB2, SB4, SB8 | |
| Public School | N7 | SB1, SB6, SB4 | All Projects Non-Functioning |
| Public Hospital | N2, N10 | SB1, SB3, SB5, SB6 | All Projects Non-Functioning |
| Public Office | N3, G1, GA2 | SB1, SB5 | SB1 (G1), SB6 (G1) |
| Public Infrastructure | N7, N6, G4, K2, S1, T2, M3, E3, E2 | SB7, SB8, SB9, SB1, SB2, SB3 | SB7 (S1, T2), SB9 (G4, T2), SB9 (G4) |

* Projects in red are either functional, partially-functional or implemented with the same period as the commencement of the study.
* Based on the expectations prior to the implementation of the corresponding project (approximately June 2017).
* Based on investigation as of January 2020.
local beneficiaries) and the comprehensible definition of the expected societal benefits. In addition, most successful projects across the region are privately owned, whereby the organizations or institutions make decisions usually on the expected return on investment. This is, however, not the case when it comes to publicly funded projects where politicians exploit public RE projects for political gains.

Analyzing the state of RE in the region is quite arduous as the access to data on these projects is usually based on physical inspection and the initiation of dialogues with all stakeholders involved. Majority of the successful projects juxtaposed with the projects in this study (publicly funded) are privately and commercially operated. Here, institutions and organizations develop their own underlying strategies to success [8]. We initiated dialogues with organizations with business projects in Nigeria, Kenya, Ghana and Tanzania to understand the recipe to the success of their projects. The underlying theme of their successes as indicated by all the organizations is the inclusion of the locals as stakeholders in the projects and the hiring, training and retention of local personnel. Whilst some of the organizations indicated their plans for expansion into other countries in SSA, they also mentioned the difficulty in dealing with governmental institutions as a barrier to greater successes. Other differences that were established include the aspect of maintenance where organizations have budgets to execute it whilst in public projects this is a case that is usually entangled in corruption. Some of the organizations stipulated the importance of shared responsibilities and community involvement to the success of their projects. There are also studies that present such an approach as a catalyst to successful projects.

Furthermore, we briefly analyzed the failures of these projects in comparison to the traditional forms of energy generation within the region. We deduced that whilst the failures of the operational processes are similar, the technical failures are utterly different. By operational processes, we refer to the processes in which the projects are designed, awarded and implemented. More so, further differences in the failures of energy projects between our study and the traditional form of energy (crude oil and natural gas) generation and distribution, is the usage, the management of technology and the frequent maintenance of the corresponding infrastructure. In Nigeria for example, it was said that losses account for more than 35% during transmission [17]. In some cases, it is estimated that more than 50% is lost due to ageing infrastructure [30]. The absence of urban planning and geographical location of homes makes it unfathomable for the extension of the grid system, since the latter is usually exploited via the sprouting of electrical lines. Furthermore, the failures of the energy crisis are institutional and governance related which instigates blatant corruption and incompetency in executing all operations [19].

4. Proposal for improvements

In essence, public RE projects are more likely to lead to failures due to the reasons presented above and thus lead to shortcomings on the societal benefits. Privately implemented projects are prone to possess a higher chance of success. However, those that fail more or less do so by the lack of due diligence, local stakeholder inclusion and reasons associated to approaches utilized in implementing public RE projects.

Several studies have been carried out in SSA [1,4,15,23,33,36,41,42], focusing on analyzing factors that should be taken into account for the selection of sustainable RETs. They further present reasons as to why these projects mal-perform from the perspective of knowledge transfer and technology [28,43,45] [46,16,40]. Moreover, [15]; provide a rather global analysis of the failures of RE projects in the region that include the political agenda of the financing government, the tendering process for projects, the encumbrance of all stakeholders, inadequate planning, poor maintenance and ill-management of implemented projects and the public acceptance and inclusion as beneficiaries.

Based on the findings illustrated in the preceding sections, we propose the following improvements:

- The introduction of RE projects to local communities should not just be about providing the habitants with power and minimizing the negative impacts of unsustainable fuel use, rather it should be about the dispersion of knowledge on the options of sustainable energy, exhibiting how these infrastructures can be implemented within the context of the locals.
- Multiple studies have been presented on the technical feasibility of RETs. However, the dependence on only the technical elements does not result in a sustainable project. This is rather dependent on the overall system encompassing the project planning, implementation, sustainable management, maintenance and monitoring. To achieve this, all stakeholders should work together intensively. An important approach to consider is end-user co-innovation and management.
- Given the heights the project beneficiaries are willing to go for the basic necessities to survive, they are willing to participate as stakeholders in these projects and in some cases to take on several tasks to ensure their success. Nonetheless, community involvement is not considered in many of the failed projects across Sub-Saharan Africa, despite its potential to contribute positively to a successful project. Project beneficiaries should be educated on the technology, its operation and benefits. Our recommendation is that the societal benefits would be achieved through a combination of training and resource provision. Thus, project developers should not only tell beneficiaries what to do or what is good, but actually provide them with the tools to do it, start doing it with them, and gradually build their knowledge and understanding through that process.
- Project developers should provide adequate planning and implementation strategies that include the corresponding local communities participating in task and shared responsibilities. This has proven to be a successful strategy in some implemented renewable energy projects.
- Project ownership and responsibility is one of the most significant problems affecting the success of RE projects. This is clearly visible from the state of failed projects. We attribute this to the lack of expertise (in some cases) and interest of the implementing government or project financiers. Lack of ownership clarity in public projects leads to the failure and deterioration of most implemented projects. The ownership of the project should not be attributed to one institution or entity (i.e., for public projects), but rather a shared responsibility between all stakeholders involved in the project. This is achievable by creating a clear distinction with respect to the ownership of the project and the responsibility of maintenance and management.
- Financiers should ensure that the process of awarding projects is transparent and projects are awarded to only competent organizations. In addition, the organizations selected to implement projects should possess strong ties to the community. In cases where this is not possible, a strategic stakeholder relationship must be actualized. Furthermore, governments should support the dissemination of RETs in the most sustainable way possible.
5. Conclusion

Our study reveals substantial differences between the expected and the actual societal benefits of utilizing renewable energy in Sub-Saharan African countries. These differences originate from various implementation errors. Although the projects are implemented in different countries, there is still a similarity between all these projects based on their failures. Given the nature of the 29 projects in this study, with only a few projects currently meeting their expected goals, the principal issue currently is to provide solutions to take into account when implementing future projects. Although it is possible to present solutions for each project investigated in this study, we have provided generic proposals for improvements in the previous section that should be taken into account by stakeholders. Nonetheless, stakeholders participating in projects should create a documentation listing out the minimum expected benefits within the local context for the implemented renewable energy projects. This could be used as a guideline for all future projects. In this way, it is easier to hold a specific stakeholder accountable for any drawbacks.

In conclusion, based on interview responses and on physical examination, the majority of the renewable energy projects investigated in this study display shortcomings in meeting their expected societal benefits in Sub-Saharan Africa. This research aims to shed light on the nature of these shortcomings. Remedies are amply provided.

CRediT authorship contribution statement

Eugene C.X. Ikejemba: Conceptualization, Investigation, Methodology, Data curation, Data collection, Writing - original draft, preparation. Peter Schuur: Methodology, Data curation, Validation, Data validation, Writing - review & editing.

Declaration of competing interest

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

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