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Opportunities and challenges to rural renewable energy projects in Africa: Lessons from the Esaghem Village, Cameroon solar electrification project

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The study's aim is to identify and analyze opportunities and challenges facing renewable energy technology (RET) penetration in Cameroon. The strengths-challenges-opportunities-responses-effectiveness (SCORE) model, a recently proposed alternative to the classical SWOT matrix is employed. A solar PV electrification project involving the co-authors in Esaghem Village, Cameroon, serve as the empirical referent. The primary data for the study were assembled during the feasibility assessment and implementation phases. The following attributes of the village are classified as opportunities: abundant solar radiation, hilltop location, self-help ethos, environmental stewardship, and effective traditional administrative system. Conversely, the following factors in, or directly tied to, the village were identified as obstacles: small economy and lack of skilled technicians, sparse spatial layout, lack of RET infrastructure, low wind speed, and intense and protracted rainy season, the outdated national energy policy, and recent international economic crisis and environmental politics. These findings hold lessons for RET policy-making and research in Cameroon and other sub-Saharan African countries. In this regard, policymakers would do well to eliminate the identified obstacles and maximize the utility of the opportunities. Future research would do well to interrogate how institutional support structures and market forms jointly or separately affect investments in RET.

1. Introduction

The severity of Africa's electricity famine is well established. With the exception of South Africa, the picture is even gloomier for sub-Saharan Africa (SSA), where only 24% of the population has access to electricity [15]. The region's per capita electricity consumption is a meager 124 kW-hours annually but steadily declining [[4], para [1]]. Half of Africa's population (or 622 million people) have no access to electricity [15,28]. Recent innovations in renewable energy have not improved the situation. The reasons for this remain unclear. The main objective of the study reported in this paper is to contribute to efforts to understand these reasons. It does so by employing the strengths-challenges-opportunities-responses-effectiveness (SCORE) model [23] to evaluate factors influencing the performance of the Esaghem Village solar PV electrification project in Cameroon.

SCORE was proposed about a decade ago as an improved variant of the strengths-weaknesses-opportunities-threats (SWOT) [23]. The main question addressed is as follows: What factors within the proximate and remote environments of Esaghem Village act as opportunities and barriers to its solar PV electrification project? Answers to this question can promote understanding of the main drivers and impediments to rural renewable energy technologies (RETs) in Cameroon in particular and sub-Saharan Africa in general. The paper contains seven sections, respectively covering the following topics: introduction, literature and conceptual model,

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main research questions, data and methodology, the Esaghem solar PV project, analysis and discussion, and policy implications and conclusion.

2. Literature and conceptual model

Several works seek to identify factors affecting the success of RETs in Africa. Examples include Njoh [24], Murombo [21,22], Ahlborg and Hammar [3], Fischer and colleagues [10], Pegels [27], Beck and Martinot [6], Painuly and colleagues [26], Painuly [25]. However, only a few have strived to identify hurdles and facilitators to RET diffusion. Three studies exemplifying this trend are by Pegels [27], Joubert and colleagues [37], Mentis and colleagues [38], Brent and Rogers [39a], and Mentis et al. [39b]. These studies have analyzed renewable energy in Africa with a view to identifying barriers, and options for their support. Pegels, for instance, focused on South Africa and identified as the main barrier, 'the economics of renewable energy technologies'—particularly, the cost and risk structures, which are two main factors in investment planning [[27], p. 4945]. On their part, Fischer and colleagues [10] focused on 'barriers and drivers to renewable energy investments in Sub-Saharan Africa.' They noted the renewable energy paradox manifested by an abundance of natural resources but a famine of energy generated from these resources. More importantly, they presented a three-part categorization schema for the classification of drivers and barriers to renewable energy. Barriers are typically rooted in: 1) the technology at hand or physical location of the project; 2) the partners and counterparts in the project; and 3) the local jurisdiction, such as the: a) general economic environment, b) institutional landscape, c) political stability, and d) reliability of local regulation.

On their part, Ahlborg and Hammar [3] focused on two sub-Saharan African countries, Tanzania and Mozambique, as opposed to the region as a whole. Like Fischer and colleagues [10], they also sought to identify drivers and barriers to renewable energy. However, their study, like the one reported here, concentrated on rural electrification. They employed a qualitative methodology and data derived from the literature and semi-structured interviews. They identified as main drivers, 'political ambitions based on expected growth demands' and local initiatives by industries and churches. Among principal barriers, they identified factors related to a lack of access to human capital, difficulties in planning, donor dependency, low rural markets, little interest from private sector and lack of technical expertise. Most studies tend to focus exclusively on barriers to renewable energy development and diffusion. For example, in an Encyclopedia entry, Beck and Martinot [6] identified energy policies as constituting a paradoxical source of some of the major impediments to renewable energy penetration in developing countries. As they contend, some energy policies 'may heighten barriers to renewable energy rather than reduce them' [[6] p. 365]. Also manifesting a propensity to concentrate on barriers to the exclusion of facilitators are, Painuly [25], and Painuly and colleagues [26]. These works identified the lack of financial resources, especially financing mechanisms, as a leading barrier to renewable energy penetration in developing countries.

A common deficiency in the extant literature on renewable energy in Africa is their lack of theoretical depth. In addition, there is a dearth of efforts to contextualize borrowed renewable energy concepts, nomenclatures, classification schemas and models to the realities of the continent. One exception, a recent study by Njoh [23], which employs the 'strengths-weaknesses-opportunities-threats' (SWOT) matrix to assess energy technologies in Africa is worth noting. The present study employs the SCORE model, also a variant of the SWOT matrix to identify opportunities and hurdles to a rural solar photovoltaic (PV) electrification project in Cameroon. In doing so, the study contributes to the negligible literature seeking to promote RETs in Africa.

2.1. The SCORE model in energy research

SCORE is a recently modified variant of SWOT, whose roots are traceable to the business world. SWOT was developed by a research team at the Stanford Research Institute (SRI) in 1960, the model was intended to assist business decision making [11,23]. Since then, the model or some variant thereof has been employed in a number of disparate areas including energy research [see e.g., 17,18,21,29,32,36]. However, in its classical form, SWOT appears to have outlived its utility and become the object of fierce criticism. One charge commonly leveled against the model is that it contains pejorative labels [24]. For instance, 'W' standing for 'weakness' in the model's abbreviated name implies inadequacy while 'T' representing 'threats,' signifies a sense of danger. Additionally, it is rather too simplistic, hence of a relatively little value for analytic purposes.

Recognition of the shortcomings of SWOT led to relentless efforts during the last decade to craft a suitable alternative. A major upshot of these efforts is the birth of the Strengths-Challenges-Opportunities-Responses-Effectiveness (SCORE) model [23]. The model is diagrammatically presented in Fig. 1 [23]. Characterized as the most versatile alternative to SWOT, SCORE evaluates decisions, technology, and other entities of concern on five fronts corresponding with its identifying acronym as follows: Strengths, Opportunities, Responses, and Effectiveness (see Table 1). These variables are not mutually exclusive; rather, they overlap and are inextricably intertwined. Note the dual directional arrows highlighting the interconnected nature of the variables on Fig. 1. For example, as the figure shows, an energy project's 'strengths' and 'effectiveness' are reciprocally linked; so too are its 'opportunities' and 'challenges.' The other symmetrical relationships are easily discernible from the figure. The model shows much promise as a tool for evaluating renewable energy. However, because it has just been recently introduced, SCORE is yet to be widely employed in the renewable energy field.

3. Main research questions

Questions of centrality relating to the Esaghem solar PV electrification project in this study are as follows:

1. What factors within the proximate and remote environments of Esaghem Village contribute positively to the project?

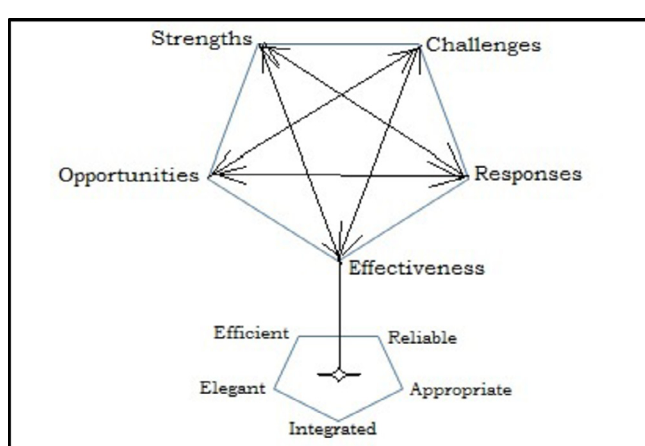

Fig. 1. The SCORE model. Source:Adapted from Graves (online).