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Impact pathways of small-scale energy projects in the global south – Findings from a systematic evaluation

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ABSTRACT

Access to clean and affordable modern energy services has been widely recognised as a significant factor for enabling social and economic development. Stand-alone systems and mini-grids are presumed to play an important role in the provision of sustainable energy to those people who currently lack access. Accordingly, an increasing number of small-scale energy projects are being implemented in developing countries and emerging economies. However, despite the large number of energy development projects, only limited evidence exists about the actual contribution they make to sustainable development. This paper addresses this research gap by providing a systematic assessment of three selected impact pathways based on the evaluation of over 30 small-scale sustainable energy projects. Applying a theory-based evaluation approach in the form of a contribution analysis, the aim of this research is to better understand if and how these types of technical interventions can create development outcomes and impacts. The results show that technological issues are often not the most decisive factor in achieving development effects, but that embedding the technology in a set of actions that address social, cultural, economic and environmental aspects is essential.

1. Introduction

Access to energy has been acknowledged as a key component in reducing poverty and supporting social and economic development [1]. Accordingly, providing affordable and reliable energy services to the energy poor is given high priority by many developing and newly industrialised countries [2,3]. However, access to energy is not the only concern; the energy supply should also be sustainable and avoid the drawbacks of conventional energy sources. Ensuring sustainable energy access is therefore featured high on the international development agenda, with the declaration of the decade 2014-2024 as the "Decade of Sustainable Energy for All" by the United Nations General Assembly [4] and the formal adoption of "affordable and clean energy" as one of the 17 sustainable development goals (SDGs). Technologies using renewable energy sources are regarded as an essential element for supplying sustainable energy, as they offer clean electricity, heating, cooking and lighting solutions to people and communities. These technologies are also considered to be particularly suitable in the development context because they can provide small-scale solutions and a decentralised energy supply to the energy poor [5].

However, despite this potential and the numerous implementations of small-scale renewable energy solutions over the last few decades, many energy development interventions fail or fall short of successfully translating into development impacts [6–8]. This is particularly true for projects addressing energy issues in developing countries [9,10]. The reasons for the lack of impact and sustainability are seldom solely technical issues; but can often be attributed to socio-cultural, institutional and/or economic aspects [11,12]. In order to enhance not only the technical aspects of development, but also the social and economic aspects, it is necessary to understand the factors that support or hinder the effectiveness of local initiatives promoting decentralised renewable energy solutions.

Albeit that monitoring and evaluation have received increased attention within the international development community over the last decade, to date few systematic efforts have been made in either the academic or practitioner literature to evaluate small-scale energy projects ($\leq$ 100 kW) in developing countries with regards to their impact on local living conditions and post-installation sustainability [9]. Although many evaluations of individual projects or national programmes are documented in the literature, there is a need to systematically evaluate and analyse the energy delivery models of small-scale projects with regards to their development impacts across technologies, energy needs and regions. According to Schäfer et al. [13], such systematic evaluations and comparison of lessons learned across countries and continents could help to develop better strategies to meet the challenge of decentralised energy supply in developing countries.

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To address this research gap, the authors conducted systematic evaluations of the outcomes, impacts and mid-term sustainability of small-scale energy projects in developing countries. The evaluated projects were all supported by the "WISIONS of sustainability" initiative,[1] which has supported over 100 projects and capacity development activities since 2004 to respond to energy needs at local level[2] via its Sustainable Energy Project Support (SEPS) scheme. The projects apply different technologies, use diverse energy sources and address different energy needs (e.g. electrification, lighting, heat supply, food processing and conservation) in distinct geographical locations.

Accordingly, the main objective of this paper is to review whether and how small-scale energy projects contribute to sustainable development and, ultimately, to achieving the SDGs. To this end, three selected impact pathways are analysed based on the evaluation results of the outcomes and mid-term impacts of 30 energy development interventions, thereby advancing the knowledge of the effects of energy projects at local level and beyond. The results can help decision-makers and stakeholders to understand the most important links that determine the success or failure of achieving impact and sustainability in small-scale renewable energy projects in developing countries.

2. Methodology

2.1. Evaluation: from aid-effectiveness to development effectiveness

The importance of evaluating the effectiveness of development interventions has been the subject of intense debate in recent decades. However, despite the increasing focus on the topic of aid-effectiveness (e.g. in the form of the Paris Declaration on Aid Effectiveness in 2005), the evidence base remains weak in comparison to the large sums spent on development aid. This fact was identified and highlighted as an evaluation gap by the Center for Global Development in 2006 [14]. Since then, the number of evaluations addressing the question "what works?" in order to provide evidence of the effectiveness have significantly increased [15]. Many donor organisations now also actively promote monitoring and evaluation, requiring evaluations of their own projects and providing guidelines and information on how to evaluate development projects in general e.g. [16–18]

Despite this, many projects still fail to conduct post-project appraisals or focus mainly on quantitative macro-level outputs [19–21]. Nowadays, however, development interventions are expected to provide not only economic growth but also improvements in living standards, empowerment, social welfare and capacity-building; all while protecting the environment. These increasingly complex and, to an extent, elusive goals are often not directly measurable, making the evaluation of development projects a challenging task [22]. Furthermore, development projects are usually temporary endeavours (lasting an average of one to three years), but human development objectives are often not achievable in the short term [19,23,24]. Therefore, ex-post impact evaluations are essential for assessing whether or not a development intervention contributes to the overall goal of human development.

Such impact evaluations should also address the questions "how" and "why" projects achieve development outcomes and impacts, instead of only asking "what works". Answering why and how interventions have impacts opens the so-called "black box" between the input activities and the observed outcomes and impacts, thereby increasing the confidence level that the intervention really is the cause of the effect [25,26]. In this way, instead of solely focusing on the aid-effectiveness, the development effectiveness is also evaluated.

In addition to the questions why and how development projects work, there is an increasing need to go beyond the evaluation of individual projects and systematically conduct multiple evaluations [27]. The results of multiple evaluations under a common framework can be aggregated and synthesised to increase the knowledge base on development effectiveness and support the development of better strategies to meet future development challenges. For small-scale energy interventions in particular, few systematic efforts have been undertaken to date that analyse whether results are context-specific or can be transferred to other regions or different technologies [12,13]. Correspondingly, a report from the UNDP [28] states that studies on the drivers of success and the sustainability of small-scale projects are limited to a small number of case studies.

The authors have attempted to address this research gap by repeating an impact evaluation of small-scale energy projects. The findings from the first evaluation cycle suggested that certain factors contributed to the creation of positive outcomes and impacts [11]; however, the first study did not analyse the links within the impact pathways and the underlining assumptions in detail, resulting in only a weak contribution claim. The analysis presented in this paper places a stronger focus on establishing the causality and contribution of impacts from a multi-site and multi-level perspective.

'Impact' in this study is understood according to the DAC definition as positive and negative change produced directly or indirectly, intentionally or unintentionally, by a development intervention. The impact of development projects should be measured against the international priorities for sustainable development [29]. This is also in line with the recommendations from the international working group for Monitoring and Evaluation in Energy for Development (M&EED) [10,30].

The timeframe for this type of post-implementation evaluation varies, but in most cases project performance is assessed within two to three years of the installation [13]. This paper evaluates projects with an average duration of twelve to twenty-four months that were initiated between 2004 and 2010. Clearly, this timeframe is not sufficient for claiming long-term success, but the fact that the technology is still functioning and being used two to ten years after its initial introduction may indicate whether long-term sustainability is likely to be achieved.

2.2. Evaluation approach: how to evaluate?

The evaluation presented aims to assess *what* happened and *if*, *how* and *why* the development projects analysed contributed to achieving development outcomes and impacts. To establish contribution claims, it is necessary to draw causal links between observed changes and the intervention. The more complex the system, the more difficult it is to determine whether an outcome was actually caused by the project itself or by other circumstances [31].

In order to establish causality, many approaches call for counterfactual analysis [32], an approach that attempts to ascertain what would have happened if the intervention had not taken place by comparing an observable world with a theoretical one [25,33]. Counterfactual analysis usually use quantitative experimental or quasi-experimental approaches. However, while these approaches are prevailing for impact evaluations in the development sector [34,35], they can usually only answer the question "what works", but cannot address why an intervention led – or did not lead to – the intended outcomes and impacts [36,37]. Hence, these approaches have been criticised as being too limited. Befani et al. [22] summarise these limitations as follows:

[1] "WISIONS of sustainability" is an initiative by the Wuppertal Institute supported by the Swiss-based foundation ProEvolution. It was launched in 2004 to promote practical and sustainable energy projects. To ensure the sustainable character of the projects supported by the SEPS scheme, their selection is based on the following set of criteria: technical viability, economic feasibility, local and global environmental benefits, replicability and marketability, potential for poverty reduction, social equity and gender issues, local involvement and employment potential, sound implementation strategy and dissemination concept. For more detailed information on the programme, please visit the website www.wisions.net.

[2] Local in this context can be understood as having a limited scope, focusing usually either on community level or individual household level.