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Energy access and pandemic-resilient livelihoods: The role of solar energy safety nets

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ABSTRACT

Lack of energy access undermines the socio-economic conditions of households, reducing their resilience, particularly in the face of disruptive effects of the COVID-19 pandemic. Hundreds of millions of poor rural households, who live in remote and difficult-to-reach areas, are still without access to energy. Solar energy safety nets, in the form of targeted social assistance programs and off-grid technological solutions, do not only advance energy access but also develop capacities of households to prepare for, respond to, and recover from specific threats like pandemics. We discuss ongoing solar energy safety net programs in the largest off-grid solar markets of Bangladesh, India, Kenya, and Nigeria, and how such programs are affected by the COVID-19 pandemic. We find that solar energy safety net programs should be maintained and updated to emphasize their potential for building pandemic-resilient livelihoods. These programs can be supported with efforts to build local value chains and economies based on clean electricity. Well-designed solar energy safety net policies generate multiple co-benefits, including the resilience of households to pandemics.

1. Introduction

Developing countries are severely affected by the current COVID-19 outbreak, with an approximate income loss of 220 billion US dollars [1]. The consequential economic and societal hardship is even more challenging in rural areas, where around 80 percent of the extreme poor reside [2]. Laborde et al. [2], for instance, estimate that the impact of COVID-19 will increase extreme poverty for an additional 70 million rural people in South Asia and Sub-Saharan Africa. Sickness and the COVID-19 containment measures restrict the availability of local informal jobs as well as seasonal labor migration, and with it the inflow of remittances in these areas [3]. Furthermore, many rural health centers on the front line of the medical response don’t have access to energy and adequate supplies [4] and cannot respond and scale up the delivery of health interventions necessary to tackle the pandemic crisis [5].

The disruptive consequences of COVID-19 pose a severe challenge to the 2030’s Sustainable Development Goals (SDG), increase social inequalities, and reverse development gains [6,7]. No doubt, the immediate goals like improving medical care and public health infrastructure are the keys to tackle a pandemic crisis. Access to energy, as a critical service provision, supports an inclusive recovery process and contributes substantially to achieve other SDGs [8]. Access to energy also improves resilience of poor communities in the longer terms, strengthening their ability to survive and thrive despite adverse changes in their environment. We argue in this paper that off-grid solar energy is a vital element of maintaining and improving resilience of hundreds of millions of poor people in the face of the ongoing COVID-19 pandemic as well as pre-existing poverty and other challenges.

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2 FAO Policy Briefs - COVID-19 and rural poverty: Supporting and protecting the rural poor in times of pandemic. Available at http://www.fao.org/3/ca8824en/CA8824EN.pdf
3 UN Secretary-General Releases 2020 SDG Progress Report. Available at https://sustainabledevelopment.un.org/content/documents/26158Final_SG_SDG_Progress_Report_14052020.pdf

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2214-6296/© 2020 The Authors. Published by Elsevier Ltd. This is an open access article under the CC BY license (http://creativecommons.org/licenses/by/4.0/).
2. Energy access, resilient livelihood and pandemic COVID-19

2.1. Last mile energy poor

Energy poverty is defined as a constraint in access and affordability of modern forms of energy, especially electricity [9]. About 85 percent of 789 million people in non-electrified households live in rural areas [10] and are known as the "last mile" of universal energy access [11,12]. The last mile energy poor are geographically located in remote and difficult-to-reach areas without access to technology and essential infrastructure services. They are often limited in productive capacity, are landless, economically poor, and less literate [13-16]. Energy poverty undermines educational enrollment, health, information attainability, and access to water, sanitation, and hygiene services [16]. This leads to a situation that the last mile energy poor fall short of overcoming structural inequalities underlying poverty and often live below $1.90 per day [17].

2.2. Pandemic-resilient livelihoods

Resilience, in a generic sense, refers to the ability of a system to persist in its current function and recover from disturbances and changes with as little damage as possible [18]. Linking it to human livelihoods, Tanner et al. [19] define livelihood resilience as the capacity of an individual to sustain as well as to improve his or her social well-being and livelihood opportunities in the face of socio-economic, political, and environmental disturbances and shocks. In response, an individual needs to develop two forms of capacities [20]: generic capacities that address human developmental deficits, and specific capacities that facilitate anticipation and preparedness to respond to specific threats. We argue that energy access helps to develop a pandemic-resilient livelihood: On a general level, access to energy helps last mile energy poor to reduce their deficiencies in education, health, and income [21]. Given access to energy, they can also further develop specific capacities to prepare for, respond to, and recover from natural and market-related livelihood risks and pandemics.

During a pandemic crisis, social distancing and staying at home is a key measure to limit the spread of communicable diseases [22,23]. Access to energy, energy-related devices, and technology is vital for the last mile energy poor, who will be better able to maintain containment measures and protect themselves from the pandemic infection [4,24]. For instance, the availability of electricity at home allows for mobile charging and communication, which give access to telehealth services [4,24]. Access to vital information about pandemics facilitates household preparedness, raises public awareness, and enables the development of community-based risk strategies to inhibit the transmission of infections [10,25–27]. Access to the internet and electronic devices allows distance learning for out-of-school rural students [10]. Chiou and Tucker [23] further report that households may remain at home if there is access to (high-speed) internet, and this increases the chances of compliance with social distancing directives. Another co-benefit of access to modern forms of energy is a reduction of household’s exposure to indoor air pollution and thereby mitigating the risk of respiratory infections, lung cancer, and other associated diseases [9,16,28]. A reduction in co-morbidity risks further enables a better immune response against COVID-19. Access to electricity can also offer home-based income streams for women, who can arrange additional earnings, for instance, by tailoring facial masks for communities and health centers during the pandemic period.5 Pandemic-resilient livelihoods in off-grid rural areas seem to be a co-benefit of energy access policy that aims to achieve universal electrification.

However, the last mile energy poor do not have access to reliable electricity. Those who have irregular and unpredictable income streams find it difficult to get connected even if (decentralized) electricity sources are locally available [29,30]. Furthermore, appliance ownership is low among off-grid households, who often lack technologies for communication services and information access [31].

In response to the current pandemic, coordinated and decisive policy action can catalyze a synergy between different sustainable development goals [32]. Djalante et al. [33], for instance, suggest integrating disaster risk resilience strategies, which include biological hazards like pandemics, with health-related goals (SDG 3). Their policy prescriptions, however, do not highlight the issue of urgent energy-related needs. In our paper, we propose to integrate the global targets of expanding energy access (SDG 7.1) and household resilience building (SDG 1.5) as an essential strategy to support the last mile energy poor and their livelihoods [4,21,24,26]. Nevertheless, providing electricity to the last mile energy poor in off-grid areas is expensive, and facilitating more (pandemic-) resilient livelihoods is therefore challenging without government subsidies and targeted material assistance [15,34].

3. Energy assistance programs

Energy assistance programs are energy-related social safety net mechanisms to reduce energy poverty for the poorest, vulnerable, and marginalized groups.6 These energy assistance programs mainly aim to reduce the affordability barrier of households that already have access to on-grid electricity [35]. Consumer subsidies are a widely adopted measure [36], and include subsidized social tariffs in Brazil [11], the lifeline tariffs and the slum electrification program in Kenya7, and the free grid electricity program in India, to name just a few [37]. However, the often generic energy access measures in the safety net programs are insufficient to reduce energy poverty [38]. Given the limited solvency of poor rural households as well as the economic and technical challenge of expanding grid in remote rural areas, the distribution of off-grid solar technology coupled with end-user subsidies can reduce energy poverty in the near term [17,39]. This is particularly suitable for off-grid non-electrified rural areas where independent solar home systems provide electricity at the household level [37,40].

3.1. Solar energy safety net programs

Several pro-poor energy programs are recently being implemented to advance the universal energy access goal in developing countries. These programs can be seen as solar energy safety nets (SESN), and implemented as government-supported schemes that target the last mile energy poor and provide, often in association with donor agencies, solar-based electricity in the off-grid non-electrified rural areas. Examples of such government-initiated solar programs are the “TR/KABITA Program” in Bangladesh, the “Saubhagyam Scheme” and the “70 Lakh Solar Lamp Scheme (Solar Urja Lamps)” in India, the “Energy and Cash Plus” and the “Kenya Off-grid Solar Access Project (KOSAP)” in Kenya, and the “Nigeria Electrification Project (NEP)” in Nigeria. In Bangladesh8 and India9, these programs provide clean energy access to the last mile

5 https://www.makingmorehealth.org/covid-19-india

6 Also called energy safety nets, a term introduced by the Sustainable Energy for All program (SEforALL) partnering with the Overseas Development Institute (ODI), and the Catholic Agency for Overseas Development (CAFOD). For details, please see www.seforall.org/data-and-evidence/energy-safety-nets-series

7 Information for Kenya’s energy safety net program retrieved from https://www.seforall.org/system/files/2020-02/ESN_Kenya-SEforALL.pdf

8 Information retrieved from the hard copy guideline for government solar program under national safety net program. For details, please see http://www.ddm.gov.bd/ and http://www.renewableenergy.gov.bd/index.php?id=124&k=1&ag=234&g=&submit=Search

9 For details, please see https://www.gogla.org/resources/peering-into-the-future-india-and-the-solar-standalone-products-market
energy poor households through free distribution of solar home systems and solar lamps. In Kenya\textsuperscript{10} and Nigeria\textsuperscript{11,12}, the subsidized solar home systems are distributed either through cash transfers or highly subsidized monthly installment payments. So far, the Bangladesh program has installed over 1,290,000 solar home systems. The Indian programs have distributed 352,000 solar home systems and 3,430,000 solar lamps. The target in the Kenyan program is to install 200,000 solar home systems, and the target in the Nigerian program is to install 1,500,000 solar home systems and 1,000,000 solar lamps.

Given the scale of the challenge, with 617 million last mile energy poor who still require basic household lighting and charging services\textsuperscript{41,42}, SESN programs require significant resources. However, even before the COVID pandemic, national political processes often stall progress in providing off-grid energy access through solar home systems. For example, the government of India, in general, advocates grid electricity to achieve the universal energy access goal and has shifted its focus from solar home systems to solar irradiation\textsuperscript{43,44}\textsuperscript{12}. The government in Kenya has not defined specific goals in the new energy policy to promote solar home systems further\textsuperscript{45}.

Beyond the narrow goal of increasing energy access, just a few programs explicitly emphasize building up resilient livelihoods. For instance, the cash incentive program in Kenya aims to increase solar energy access of the targeted beneficiary groups as well as reduce their exposure to indoor air pollution by replacing the use of firewood at home with efficient lighting. The program also encourages beneficiaries to enhance family earnings by setting up a business, for instance, for phone charging services. The study lamp scheme in India aims to provide necessary lighting for rural students and to empower rural women by engaging them in the assembling and distribution of solar lamps. The other programs mainly provide access to basic energy needs and don’t have an explicit focus to build up household resilience in general and to fight against pandemics in particular.

4. Solar energy safety nets in times of pandemic

4.1. Initial effects and responses

The COVID-19 containment measures hit both the rural poor who live on informal employment and those (peri-) urban households who either have lost their jobs or have limited access to the teleworking facility hard\textsuperscript{3}. These newly poor households experience difficulty in paying for energy services due to insufficient income opportunities. This increases energy insecurity in the short term and may lead these households to fall back into the energy poverty trap. In response, several policy measures to mitigate growing energy insecurity of grid-connected households have been put in place by governments around the world. These include disconnection bans, payment extension plans, and energy bill reductions or cancellations\textsuperscript{24,35}.

Alongside the growing energy insecurity of the newly poor households, the energy access problems for the last mile energy poor remain. Due to the disruption of supply of solar home system components like solar panels and batteries, off-grid energy firms also find it challenging to expand energy access during the pandemic\textsuperscript{46,47}. In response, a few African countries with high rates of energy poverty announced specific interventions to deal with last mile connectivity. Such interventions involve a 50\% reduction in the price of solar kits for rural households in Burkina Faso, an allocation of a $500,000 relief fund to the (off-grid) renewable energy firms in Nigeria, and the REACT Kenya Relief Fund of $2 million to off-grid energy firms in Kenya\textsuperscript{48}. Additionally, a few off-grid solar service providers offer reduced weekly payments or bonus energy consumption to poor rural households so that they can continue lightening their homes during the pandemic crisis\textsuperscript{13}. However, deferred payments don’t reduce the total cost of solar home systems and will prolong households’ debt burdens. This adds continued economic pressure on affected households in addition to unforeseen socioeconomic impacts of the COVID-19 pandemic.

Furthermore, while financial support to mitigate the impacts of COVID-19 is welcome, governments in developing countries experience a limited fiscal space to respond to the current crises\textsuperscript{1,6,14}. As a quick solution, governments mobilize as well as divert resources to COVID-19 recovery programs that need immediate financial assistance. For instance, ILO\textsuperscript{3} report that nearly 200 countries expanded existing social protection programs and adapted 1,166 social protection measures, particularly for health, income and unemployment protection, and job protection. This shifting priority, and the instability in the national energy policy that is discussed in Section 3, weaken existing policy measures that support SESN programs and thereby threaten energy access for the last mile energy poor\textsuperscript{41,48}.

Diversion of substantial allocated funds from existing SESNs to these COVID-19 recovery programs can disrupt the operation of solar service providers. This will cause many of them to exit the market, as is the case for the TR/KABITA program in Bangladesh\textsuperscript{14}, where the government has diverted substantial funds from this program to other national safety net programs, like food consumption for 28 million people, cash transfer aid for over three million people\textsuperscript{14,15}, and home construction for 600,000 poor people in the disaster-prone areas\textsuperscript{16}, to mitigate the negative impacts of the COVID-19 pandemic and the cyclone Amphan.

Diverting resources affects not only new solar home systems but also the systems that are already installed. For instance, regular maintenance is crucial for solar home systems to function correctly and maximize energy generation, particularly during pandemics and other rapid and slow-onset disasters. The last mile energy poor often can’t manage regular operational and maintenance expenditure of solar home systems\textsuperscript{49}. Governments often have binding contractual agreements with solar service providers for maintenance support for at least 3–5 years after installation of solar home systems. During a pandemic crisis, lost income from sales, deferred or canceled payments, and canceled or suspended maintenance contracts all create financial stress for the solar service providers, who may then become limited in their capacity to continue regular maintenance services. Even before COVID-19, the total amount paid for a particular solar home system by a household did not always cover the costs incurred by the solar service providers, and this challenges the financial sustainability of the providers\textsuperscript{39}.

As a result, last mile energy poor households will be unlikely to escape out of energy poverty, and many households who previously escaped will fall back into energy poverty. The loss of the resilience benefits from having access to modern energy will make these people more vulnerable to pandemics and the resulting shocks.

\textsuperscript{10} For details, please see http://documents.worldbank.org/curated/en/212451501293669530/pdf/Kenya-off-grid-PAD-07072017.pdf
\textsuperscript{11} For details, please see http://documents1.worldbank.org/curated/en/367411530329645409/pdf/Nigeria-Electrification-PAD2524-06052018.pdf
\textsuperscript{12} See endnote ix
\textsuperscript{13} https://nextbillion.net/impact-of-covid-19-solar-payments/
\textsuperscript{14} In an official request letter, dated May 05, 2020, the IDCOL Partner Organization (PO) Trust Forum, addressing to the Deputy Minister, Bangladesh Ministry of Disaster Management and Relief, appealed for continuous financial support for the TR/KABITA program in the face of pandemic disasters. The authors also had online correspondence with the member(s) of the PO forum in April-May, 2020.
\textsuperscript{15} South Asia economic focus, Spring 2020: The cursed blessing of public banks. Available at https://openknowledge.worldbank.org/handle/10986/33478 and https://www.orfonline.org/expert-speak/how-bangladesh-is-addressing-the-covid19-pandemic-65601/
\textsuperscript{16} https://edition.cnn.com/2020/05/21/weather/india-bangladesh-aftermah-cyclone-amphan-intl-hnk/index.html and https://healthpolicy-watch.news/cyclone-amphan-relief-efforts-ramp-up/
4.2. Extended policy response for solar energy safety nets

Solar energy safety nets depend on supportive policy measures to continue to deliver energy access and resilience benefits. Continued public financing is essential in maintaining and expanding energy access for the last mile energy poor. To best address COVID-19 pandemic shocks, existing programs should be updated to be very explicit about the resilience benefits that they are intended to achieve, both in general and in practical implementation. Updating the programs further, based on these targets, would maximise the co-benefits resulting from SESN programs and support addressing energy access and resilience building in tandem [8,41].

Looking forward, a well-developed SESN program also provides opportunities to emerge stronger from the current crisis:

First, solar energy based employment opportunities in the locality can increase family earnings of the last mile energy poor, and enable them to manage their periodic energy expenditures, including other basic needs. The government, along with SESN program implementing agencies, can provide training for developing technical skills to the last mile energy poor. They then can set up small-scale energy shops to facilitate after-sales services in remote rural areas [50,51]. These small energy shops can also strengthen the local supply chain and distribution network of solar home system components. Such a mechanism, linked to capacity building, creation of local jobs, and strengthening value chain, creates a supportive ecosystem for rural livelihoods [8].

Second, the availability of energy-efficient appliances for lighting, comfort, communication services, and increased productivity is inevitable to maintain health and life, particularly during a pandemic crisis. Access to affordable energy appliances for females and female-headed business enterprises further promotes gender equality [41]. The government may, for instance, distribute cash equivalent vouchers, which can help last mile energy poor to buy efficient solar-powered lights, radio, television, mobile and internet accessories, as well as milling and milking machines [8,52]17. Such appliances allow the energy poor to realize a wide range of energy access benefits and can help them work their way out of the energy poverty trap [53].

5. Concluding remarks

The vulnerabilities stemming from energy poverty disproportionately affect millions of rural poor in developing countries, limiting their capacity to escape the vicious cycle of poverty and cope with pandemics like COVID-19. This stresses the importance of advancing the SDG 7.1 goal of universal access to modern energy together with the SDG 1.5 goal to build pandemic-resilient livelihoods. Off-grid solar represents a potent technology to serve the last mile energy poor in remote and challenging-to-reach areas [43,54], and improve their resilience. Targeted policies like solar energy safety nets programs can advance energy access for these last mile energy poor and provide multiple co-benefits.

However, shifting priorities threaten SESN programs in different countries; At the outset of COVID-19, the Bangladesh government has diverted funds from the existing solar energy program to other safety net programs that address emergency crises. The government in India, in general, has shifted its policy focus to solar irradiation. However, the off-grid solar energy firms in Kenya and Nigeria have received relief funds to cope with supply disruption and liquidity crisis. Continued support for, and updated emphasis on resilient livelihood building in SESN program will improve the ability of last mile energy poor to cope with the COVID-19 pandemic and other shocks.

A final suggestion is to keep long-term objectives in policy focus, even in a short-term crisis. By leveraging the co-benefits of renewable energies, governments can integrate transformational policies into a green industrial strategy to improve the livelihood, reduce poverty, and protect both the local environment and the global climate [32]. The developmental interventions in renewable energy programs and climate change adaptation, therefore, move in tandem to enhance pandemic-resilient livelihoods and to mitigate future risk exposures while slowing down environmental degradation.

Declaration of Competing Interest

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

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