

THE SOCIO-ECONOMIC IMPACT OF SUPER-EFFICIENT OFF-GRID FANS IN BANGLADESH

JUNE 2019

EFFICIENCY FOR ACCESS COALITION



This report summarises telephone survey results from 1,600 off-grid fan customers to better understand the impact and socio-economic value of fans in Bangladesh.

Data for this report were collected as part of a results-based financing (RBF) mechanism led by CLASP that supported the sale of 194,000 best-in-class, super-efficient off-grid fans in Bangladesh. RBF mechanisms aim to catalyse the uptake of high-quality super-efficient appliances by 1) lowering the cost to procure large volumes of best-in-class off-grid appliances for early mover off-grid solar companies, and 2) facilitating new business partnerships for appliance suppliers that have invested in the production of high-quality off-grid appliances.

This report was developed by CLASP as part of the Low Energy Inclusive Appliances program (LEIA), a flagship program of the Efficiency for Access Coalition. Efficiency for Access (EforA) is a global coalition working to promote high-performing appliances that enable access to clean energy for the world's impoverished people. EforA is a catalyst for change, accelerating the growth of off-grid appliance markets to boost incomes, reduce carbon emissions, improve quality of life and support sustainable development.

The EforA Coalition is jointly coordinated by CLASP, an international appliance energy efficiency and market development specialist non-for-profit organisation, and the United Kingdom's Energy Saving Trust, which specialises in energy efficiency product verification, data and insight, advice, and research.

The LEIA team is especially grateful to dataWhiz, a third-party verification agent for conducting the telephone surveys and collecting data, to Michal Pietrkiewicz, an independent consultant, for leading the design and analyses in this report, and to Asif Hassan of CLASP for thought leadership, content review, and managing the overall process.

We also thank GOGLA for participating in the peer review process and kindly providing feedback that strengthened the analyses presented in the report. Finally, we are grateful to numerous experts within CLASP who took time to review this report and provided invaluable feedback.

This report has been funded by UK aid from the UK government. The views expressed do not necessarily reflect the UK government's official policies.



Context	2
Table of Figures	4
Introduction	5
Methodology	5
Overview of Respondents' Profile	6
Findings	7
Users' Ability to Work More Efficiently	7
Health Benefits for Households	9
Improved Energy Access for Households	10
Market Creation for Efficient Solar Technologies	10
Conclusions and Key Findings	12
References	13

TABLE OF FIGURES

Figure 1: Distribution of the sample by division	6
Figure 2: Distribution of sample household size	6
Figure 3: Respondents reporting improvements in quality of life	7
Figure 4: Extra productive time for fan consumers.	8
Figure 5: Activities shifted indoors after purchasing a fan	8
Figure 6: Share of people who observe improvement in terms of heavy sweating and dehydration symptoms.....	9
Figure 7: Share of people who see a general improvement in terms of their families' health	9
Figure 8: Sources of electricity used for powering fans by home users	10
Figure 9: Improved energy access for households	10
Figure 10: Satisfaction with the purchased fan and reported issues	11
Figure 11: Share of customers who are planning on buying another fan	11

INTRODUCTION

Fans are one of the most common appliances in the world, with over 260 million sold in 2016. Elevated average temperatures and rising disposable incomes have placed fans in high demand across South Asia. In Bangladesh, fans rank third among the most desired household appliances. In 2016, CLASP¹ and its implementation partners initiated a results-based financing (RBF) mechanism in Bangladesh through the Efficiency for Access Coalition (EforA) to catalyse the uptake of high-quality, super-efficient off-grid fans.

Bangladesh is an ideal market for super-efficient off-grid fans. The nation's harsh tropical climate heavily influences its culture, economy, and demand for affordable and sustainable cooling solutions. Average temperatures have risen considerably over the last 60 years in Bangladesh. Evidence suggests the need for cooling will increase as the planet warms. Bangladesh is expected to see average temperature increases by as much as 2.8 degrees Celsius over the next four decades. The frequency of extremely hot days and nights² is also projected to increase. By the end of the century, extremely hot days will occur as often as 50% of the time.³ Access to cooling will therefore be critical to ensuring safe households, workplaces, and communities for all Bangladeshis.

Despite their popularity, the distribution of fans in South Asia is not uniform. Urban markets in hot and humid climates see penetration rates of 70% or higher, while trends in rural markets are much lower. The estimated penetration of electric fans in rural Bangladesh, for example, is 41%. These gaps in market penetration are reflective of larger gaps in access to energy between urban centers and rural communities. While the electrification rate in Bangladesh has improved, 146 million people still lack reliable access to electricity. In areas with low rates of electrification, households could benefit substantially from access to modern energy services and the devices they power.

Fans account for a significant proportion of energy consumption in South Asian countries, underscoring the importance of energy efficiency. In India, ceiling fans accounted for 6% of residential energy use alone in 2000. Gains in energy efficiency could therefore reduce energy demand and greenhouse gas emissions. Energy efficiency is also an important factor for off- and weak-grid communities. Many solar home system (SHS) customers must factor in the capacity of the system when purchasing a new appliance.

Improvements in the energy efficiency of fans could create positive technological spillover effects for motor-driven appliances such as pumps, grinders, mills, hand-power tools, and sewing machines. These appliances will benefit strongly from continued innovation, cost reductions, and scale in the brushless DC (BLDC) motor markets. Due to their current market penetration and high demand, super-efficient off-grid fans could help drive significant gains in the price and efficiency of BLDC motors, further inspiring manufacturers and distributors to invest more heavily in the market.

Despite their potential to deliver significant social, economic, and environmental benefits, reliable data on the impacts of super-efficient off-grid fans is generally sparse. This report seeks to fill important knowledge gaps by assessing the socio-economic impacts of super-efficient off-grid fans in Bangladesh.⁵ Data for this report were collected through a RBF mechanism led by CLASP, which allocates incentives to the Winners and Finalists of the Global LEAP Awards.⁶ The RBF mechanism in Bangladesh supported sales of about 194,000 best-in-class off-grid fans. CLASP leveraged RBF data collection opportunities to better understand the impact and socio-economic value of fans in Bangladesh. The large number of customers who purchased fans through the RBF mechanism allowed CLASP to both study the potential impact of access to cooling on families and businesses and assess what is needed to further develop the market for super-efficient off-grid fans.

METHODOLOGY

The data presented in this report is representative of the population of customers who purchased fans supported under the RBF mechanism in Bangladesh from 2017 to 2019. Two distributors participated in this RBF mechanism, Super Star Group (SSG) and Rahimafrooz Renewable Energy Ltd. (RREL). Sellers of RBF-supported products documented the basic demographic information and phone numbers of customers that purchased the supported fans. CLASP, in collaboration with a third-party verification agent, dataWhiz, randomly selected a set of consumers to conduct a telephone survey about appliance use, customer experience, and impacts. The data referenced in this report between were collected by dataWhiz between November 2018 and March 2019. During this time, dataWhiz attempted 7,751 calls to 5,159 unique numbers. CLASP through dataWhiz instructed the surveyors to attempt to call each of the randomly selected numbers up to three times and only after three consecutive unsuccessful calls they would classify a number as unreachable.

1. An international and impartial nonprofit organization first established in 1999 to mitigate the growing energy demand from the use of appliances, lighting, and equipment in the developing world. More: <https://clasp.ngo/>

2. 'Hot' days and nights are defined as the hottest 10% of days and nights measured in years 1970-1999

3. McSweeney, C., New, M. & Lizcano, G. (2010). UNDP Climate Change Country Profiles: Bangladesh.

4. CLASP (2016). State of the Off-Grid Appliance Market.

5. CLASP (2017). Off- and Weak-Grid Appliance & Equipment Technology Summaries.

6. The Global LEAP Awards identify and promote super-efficient, best-in-class off-grid appliances. Through its RBF program, CLASP has supported the delivery and enhancement of energy access for over one million beneficiaries across Bangladesh and East Africa

dataWhiz then cleaned the collected data, eliminating incomplete or incoherent answers. Out of 5,159 selected customers who participated in the survey, only 1,614 customers provided a full range of information about their purchase (i.e. name, address, product name, brand, model, price, date of purchase). The report sample consisted of 81% SSG and 19% RREL customers. dataWhiz ensured that the sample remained random and analysed variables show high levels of statistical confidence.

Overview of Respondents' Profile

Ninety-three percent of the sample were male. The average household size of the sample was 5.3 people, with two-thirds of the household size falling into the range of three to six people. Thirty-eight percent of all respondents' households reported trade as their main source of income, followed by various salaried jobs (32%) and agriculture (18%). Almost all respondents (97%) stated that they used their fans at home, rather than at their jobs. Only 28% of households in the sample had used electricity from the grid for lighting before they purchased a fan.

Figure 1: Distribution of the sample by division

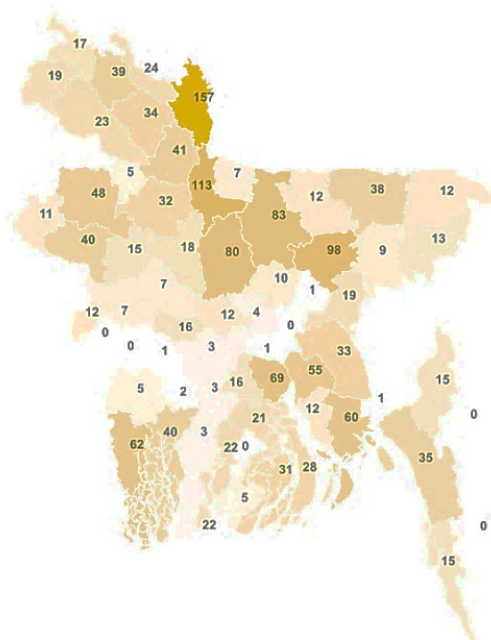
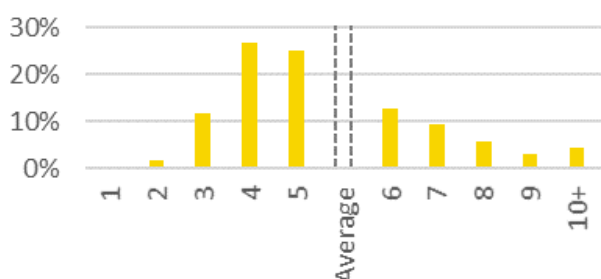


Figure 2: Distribution of household sizes in the sample



Source: Bangladesh Impact Survey



FINDINGS

Survey data overwhelmingly support assumptions about the positive impacts of super-efficient off-grid fans and their ability to catalyse the market for solar technologies in Bangladesh. The vast majority of our sample (81%) believed that their lives had improved after purchasing a super-efficient off-grid fan (see Figure 3). This report details different dimensions of these life improvements. Specifically, it looks at four areas of impact, the first three at the household or business level, and the fourth at the market level. The subsequent sections of this report explore these specific impact dimensions, in the following order:

1. Users' ability to work more efficiently
2. Health benefits for households
3. Improved energy access for households
4. Market creation for energy-efficient solar technologies

Users' ability to work more efficiently

Impact on household and business productivity⁷ and ability to work longer hours

Research suggests productivity decreases on hot and humid days. Higher temperatures decrease humans' physical and cognitive performance, making it harder for people to complete basic tasks. Evidence indicates that in countries with already high average temperatures, such as Thailand, India, or Nigeria, individual productivity reduces by as much as 4% for each one-degree Celsius increase in average temperature.⁸

Low- and middle-income countries often experience the harshest climates and are most vulnerable to the adverse effects of climate change. As a result, their relative economic position

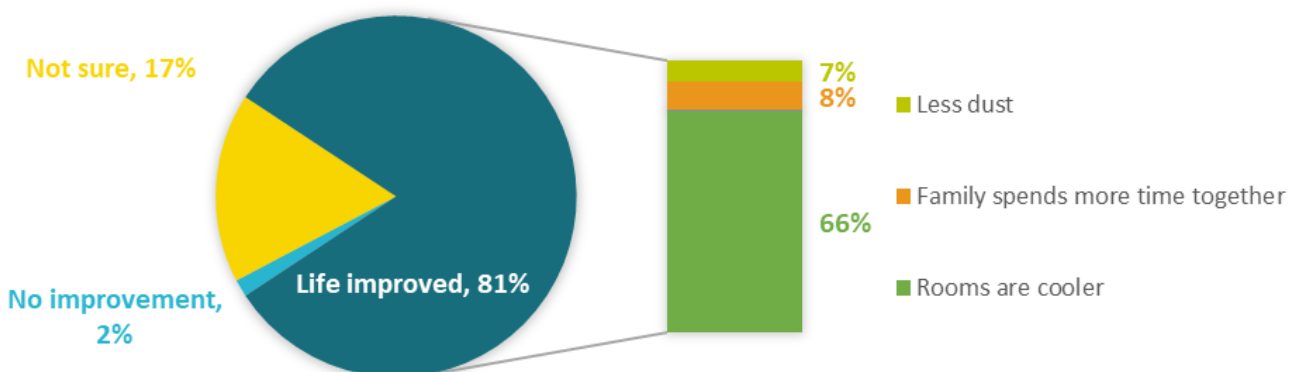
is likely to worsen as the planet warms.⁹ Cooling technologies have the potential to mitigate the consequences of extreme temperatures. Unfortunately, many low- and middle-income countries do not have universal access to energy infrastructure and many experience economic challenges. For example, Bangladesh, one of the countries most vulnerable to the dangers of climate change, lacks widespread air-conditioning, modern and well-ventilated workspaces and, intelligent buildings. As people in low- and middle-income countries are exposed to more dangerous temperatures and greater warming effects, global inequality may worsen.

Environmental health is critically important to low- and middle-income countries like Bangladesh due to a greater reliance on physical manufacturing work and labor-intensive agriculture. Research suggests that physical workers work one hour less on days that reach over 29 degrees Celsius – commonplace temperatures for nine months of the year in Bangladesh.¹⁰ This particularly affects workers' abilities in labor-intensive agriculture, construction, and manufacturing, all critical contributions to the national economy.

Expected impact on productivity

Most of the customers surveyed through the RBF bought fans for household use in a bedroom or living room area. We therefore assume that people working at home with their fan are able to work more efficiently, for work longer hours, and complete a range of activities indoors. In Bangladesh, the elderly, children, and women often work from home.¹¹ They cook, process food, study, and take care of children in traditional clay houses prone to high temperatures, indoor air pollution, and insufficient natural light. We therefore estimate primary productivity-related gains of super-efficient off-grid fans to apply to these user groups and activities.

Figure 3: Respondents reporting improvements in quality of life



Source: Bangladesh Impact Survey

7. The ability to work longer hours.

8. Heal, G., Park, J. (2014). Feeling the Heat: Temperature, Physiology & the Wealth of Nations. National Bureau of Economic Research.

9. World Bank Group. (2016). Bangladesh: Building Resilience to Climate Change.

10. Graff Zivin, J., Neidell, M. (2014). Temperature and the Allocation of Time: Implications for Climate Change. *Journal of Labor Economics*, University of Chicago Press. Vol. 32(1), pp. 1-26.

11. Cain, M. (2010). The Activities of the Elderly in Rural Bangladesh. *Population Studies*. Vol 45, no. 2, 1991, pp. 189-202.

Productivity gains—field observations

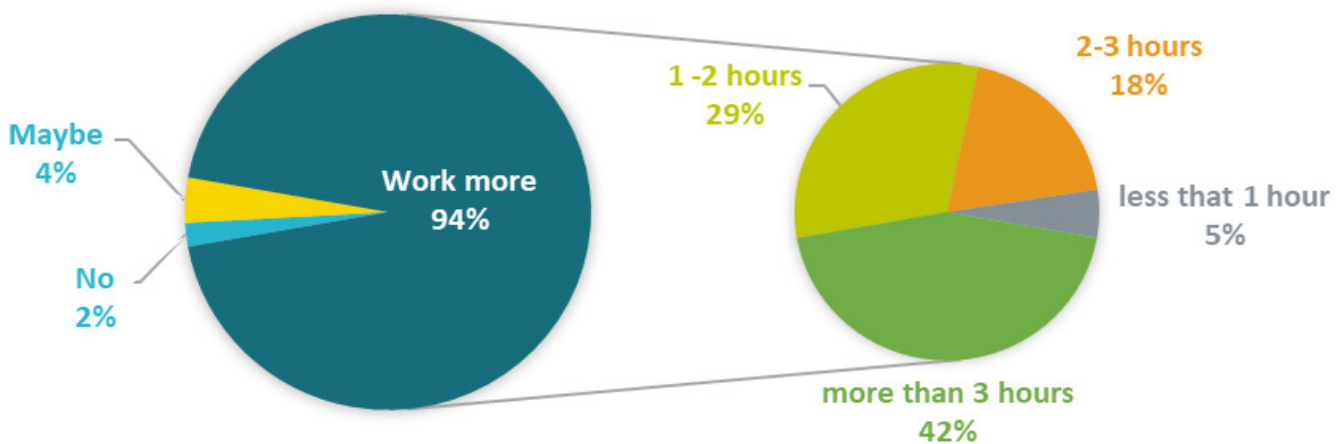
Most of the households surveyed stated their fan allowed them to extend their productive time. The average self-reported number of extra work hours with a fan was 2 hours and 20 minutes a day.¹² The reported additional productive time conforms with research linking heat reduction to productivity.¹³ Forty-four percent of survey respondents said that they enjoy “three hours or more a day” of extra productive time with their fan, suggesting that most of the families feel very strongly about the impact on their productivity.

Sixty-five percent of survey respondents stated that super-efficient off-grid fans allow their families to shift activities, such

as family discussions or food processing, indoors. In the case of rural Bangladesh, where many families live in mud houses that are too hot for indoor work, the ability to move work indoors is a significant improvement. The ability to work and enjoy family time inside contributes to overall comfort and safety, and allows people to continue working in the evening free from insects.

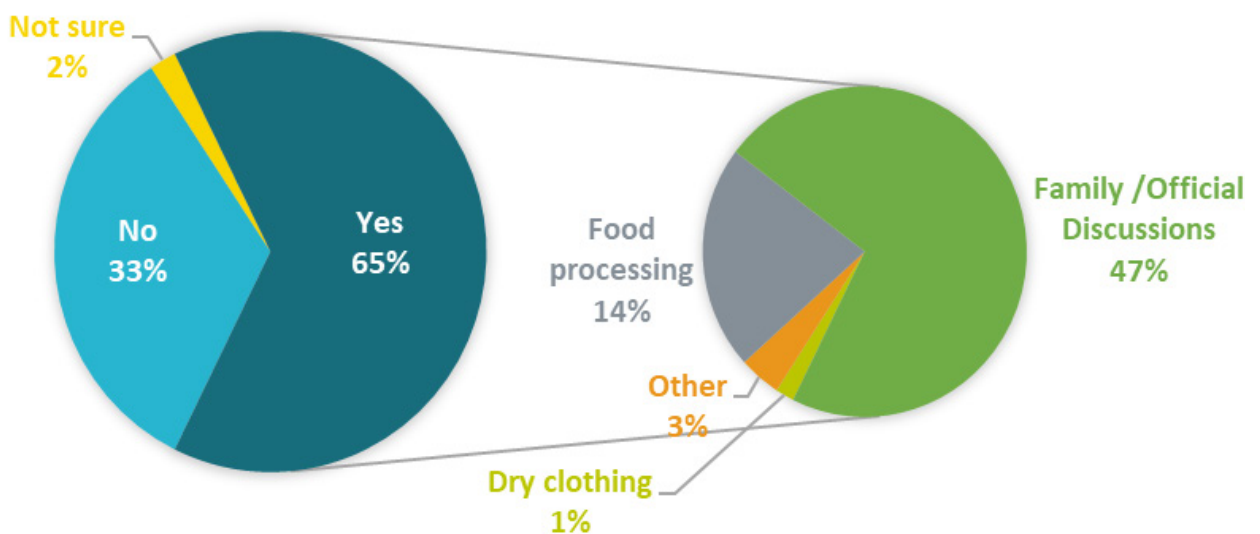
Three percent of the sample used their super-efficient off-grid fan for business purposes. Like households, survey results show a positive impact of fans on business productivity. Most business owners indicated that their fan has enabled them to serve more customers. As a result, the majority of the businesses reported an increase in revenue since purchasing their super-efficient off-grid fan. This conclusion is not very robust considering the very small sample size.

Figure 4: Extra productive time for fan consumers



Source: Bangladesh Impact Survey

Figure 5: Activities shifted indoors after purchasing a fan



Source: Bangladesh Impact Survey

12. Calculated using mid-points and the minimum possible value for right censored data

13. Back-of-the-envelope calculation assumes that respondents add 2 hours 20 minutes to an 8-hour day, equivalent to a 30% productivity gain.

Health benefits for households

Hot and humid environments increase the risk of serious health conditions, such as heatstroke and temperature-related heart problems. While super-efficient off-grid fans do not reduce the air temperature like air conditioners, they aid by removing warm and humid air and replacing it with drier air that helps to reduce one's body temperature.¹⁴

The use of super-efficient off-grid fans can also help improve indoor air quality by reducing pollution and the presence of mold-related allergens through improved ventilation. In Bangladesh, 80% of people rely on biomass for cooking fuel.¹⁵ Biomass cooking along with the use of kerosene lamps can create unhealthy indoor environments. Indoor air pollution is reported to cause over 100,000 premature deaths every year. Since women, the elderly, and children are more likely to spend more time in poorly ventilated households, their exposure to pollution-related risk is disproportionately high. The exposure risk for indoor air pollution is four times greater for women than for men.¹⁶ Similarly, reducing humidity, super-efficient off-grid fans also help reduce the prevalence and spread of mold allergens, which have been attributed to respiratory diseases affecting children and the elderly.

Finally, the increased airflow from super-efficient off-grid fans reduces exposure to mosquitoes. In Bangladesh, mosquitoes are carriers of serious threatening diseases like such as dengue fever and malaria. As mosquitoes are relatively weak fliers, fans are a simple defense against them.¹⁷ Fans also help disperse CO₂ and other human emanations, which insects use to localise people.¹⁸ While further research would be needed to confirm the impact of using super-efficient off-grid fans on the odds of contracting mosquito transmitted diseases, the lower exposure to insects is likely to reduce the risk.

Expected impact on the health of household members

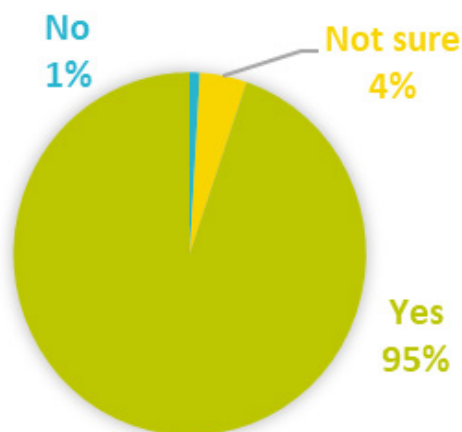
We predicted that fan users would see a positive impact of better ventilation, feeling cooler, better health, and a reduction in mosquito populations. The survey included questions on observable symptoms related to diseases, respondents' health awareness, and the prevalence of mosquitoes in places where super-efficient off-grid fans are used.

Health benefits: Field observations

Ninety-two percent of respondents noticed a positive impact of super-efficient off-grid fans on the health of their families. Respondents noticed that they felt less dehydrated and that they sweat less, both strong indicators of the overall improvement of health and reducing the risk for serious health conditions.

81% of surveyed users stated that super-efficient off-grid fans reduced the number of mosquitoes in their houses. At the time of the survey, Bangladesh had just recorded its deadliest outbreak of mosquito-borne dengue fever cases in decades¹⁹, underscoring the health benefits of widespread fan use.

Figure 6: Share of people who observe improvement in terms of heavy sweating and dehydration symptoms



Source: Bangladesh Impact Survey

Figure 7: Share of people who see a general improvement in terms of their families' health



Source: Bangladesh Impact Survey

14. Applicability of whole-body heat balance models for evaluating thermal sensation under non-uniform air movement in warm environments

15. Clean Cooking Alliance. (n.d.).

16. Dasgupta, S., Huq, M., Khaliqzaman, M., Pandey, K. and Wheeler, D. (2006). Who suffers from indoor air pollution? Evidence from Bangladesh. Health Policy and Planning. Vol 21(6), pp.444-458.

17. Mosquito.org. (n.d.). FAQ - American Mosquito Control Association.

18. Broad, W. (2013). A Low-Tech Mosquito Deterrent. The New York Times.

19. Savage, S. (2018). Deadliest year for dengue fever in Bangladesh as cases explode in Dhaka. The Guardian.

Improved energy access for households

Availability of cheaper and more energy-efficient appliances translates to better access to energy services. With a relatively low level of grid penetration in Bangladesh²⁰ and frequent and prolonged blackouts, a super-efficient off-grid fan is a step toward better access to energy services. Super-efficient off-grid fans can run independently from the electric grid when coupled with a PV panel or a battery backup, helping users who live far away from the grid or suffer from its low grid reliability gain access to dependable power supply.

Fans promoted by the RBF mechanism were selected based on their efficiency and the potential to reduce the cost of use. Regardless of whether they are used with a SHS or powered by the grid, super-efficient off-grid fans reduce the cost of electricity needed to power them. Reduction in the price translates into better access, especially for resource-constrained households.

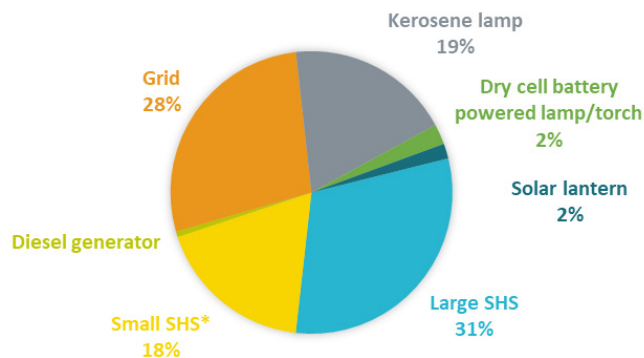
Nearly 45,000 households who bought a fan with a SHS gained access to modern lighting, which is arguably the most basic criteria when assessing access to modern energy. Households were asked about their main source of electricity for lighting prior to buying the fan. For about 25% of the users, the new purchase means that for the first time they will be using modern electricity and will be able to upgrade from dangerous and inefficient kerosene lamps or torches.

Many of the fans sold under the RBF came as part of a set with a PV system, and in some cases, as part of a full SHS able to power a wide range of basic appliances. For the users who bought a full set, the improvement in the access to modern energy was significant because they were then able to power additional basic appliances, such as phone chargers, lights, TVs and computers.

Expected impact of super-efficient off-grid fans on energy access

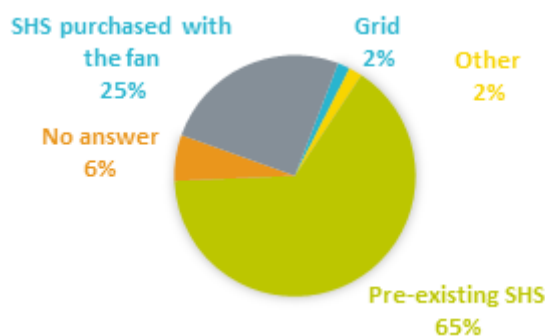
We predicted the purchase of a super-efficient off-grid fan would help households enjoy higher reliability of the appliance, lower the cost of use, and serve as a potential gateway to greater appliance usage. There are multiple, context-dependent, channels through which new owners of a super-efficient off-grid fan could see increased access to energy services. For those connected to the grid but facing significant financial constraints, a solar-powered, energy-efficient fan should mean financial savings and getting more value with the same level of electricity consumption. For others, a super-efficient off-grid fan was expected to become a trigger, incentivising the purchase of a solar unit that can be used to power other appliances. This in turn can reduce household dependence on an unreliable grid, reducing the cost of electricity and CO₂ emissions, and expanding the range of appliances families use.

Figure 8: Sources of lighting for households before buying a solar fan



Source: Bangladesh Impact Survey

Figure 9: Source of electricity use for powering the fan by home users



Source: Bangladesh Impact Survey

Improved access to energy and energy services field observations

Nearly all of respondents powered their super-efficient off-grid fan with a SHS and 25% of home users bought a SHS with the fan. In Bangladesh, it is common for appliance retailers to sell fans with a SHS package that includes LED lights, TVs, and phone chargers, therefore a super-efficient off-grid fan becomes a part of a system that significantly improves household's energy access. The 25% of the buyers who bought a full SHS are now able to use a range of previously inaccessible basic appliances. For the 69% of buyers who already owned a SHS, the new purchase increases the value of the system and emphasizes the scalability of a SHS with the increased availability of energy-efficient appliances that do not require users to increase systems' power.

Market creation for energy-efficient solar technologies

Promoting super-efficient off-grid appliances can accelerate a paradigm shift towards energy-efficient clean energy access. The global off-grid appliance market, despite recent gains, remains nascent throughout much of the world. A vast majority of appliance users are still unaware of the benefits of super-efficient off-grid appliances. The price of these appliances remains higher than traditional devices. As a result, many potential customers consider the purchase of a super-

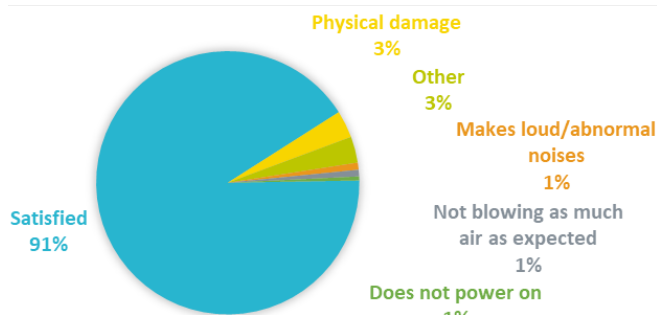
20. Energypedia. (n.d.). Bangladesh Energy Situation.

21. Anderson, J. (2017). National Survey and Segmentation of Smallholder Households in Bangladesh: Household Level Data. Consultative Group to Assist the Poor

efficient off-grid appliance as a high-risk investment. For many Bangladeshi customers, super-efficient off-grid fans create an opportunity to test solar technology for the first time. Super-efficient off-grid fans, therefore, have the potential to support a technological leap towards efficiency and wider use of solar.

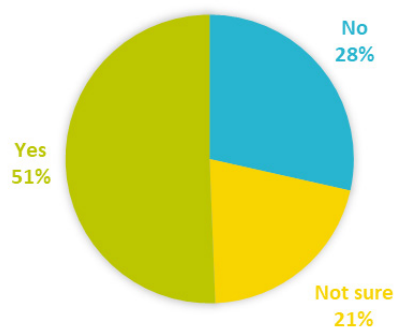
Super-efficient off-grid fans are an appropriate catalyst for other solar technologies in Bangladesh. Fans are widespread across Bangladesh, with penetration levels around 60%.²¹ Fans are also relatively inexpensive, and early adopters are likely to perceive the associated risk of buying an unfamiliar product to be relatively low. Finally, fans are used by people from a variety of socio-economic backgrounds, suggesting their potential to improve recognition of the technology across a wide group of customers. Between July and September of 2018, CLASP conducted 55 in-depth interviews with appliance sellers across Bangladesh and documented their perspective on the market. Most of the interviewed sellers have seen an increase in demand for appliances (i.e. fans, TVs, irons, cell phones, refrigerator, solar water pumps) among consumers. Sellers confirmed that increasing demand seems to be strongest for TVs and refrigerators, which until recently, have had not been popular among middle-income consumers. In contrary, they have seen a decrease in phone sales. This suggests that the high-growth phase for mobile phones may be over, and the market is reaching saturation.²²

Figure 10: Satisfaction with the purchased fan and reported issues



Source: Bangladesh Impact Survey

Figure 11: Share of customers who are planning on buying another fan



Source: Bangladesh Impact Survey

Expected impact on the position of super-efficient off-grid fans and solar technologies in Bangladesh

Early adopters of super-efficient off-grid fans have the potential to motivate more conservative buyers and stimulate market growth. The expectation was that after adopting super-efficient off-grid fans, users would gain confidence in solar technologies and appliances and be more likely to purchase additional appliances and share their positive experience with others. Super-efficient off-grid fans may therefore serve as catalyst for more advanced and expensive solar appliances, such as TVs or refrigerators.

Market creation for super-efficient off-grid fans: Field observations

Ninety-one percent of respondents reported that the super-efficient off-grid fans they purchased work as expected. For the remaining 9% of respondents, the concerns were often related to some form of physical damage but proved unlikely to influence users' general perceptions of the quality of solar appliances. Out of this 9%, only 2% of customers described a negative experience (such as not enough power or the device not turning on) that they may consequently attribute to solar technology.

Over 50% of consumers reported that they need and will buy another fan. Therefore, the positive experience with the users' first fan purchase often directly led to an additional purchase, thereby strengthening the process of market creation.

The positive experience of one consumer is likely to be passed by word-of-mouth and lead to more purchases. Eighty-nine percent of buyers claimed that they have recommended the fan to another person. These positive experiences will likely have a significant impact on super-efficient off-grid fan sales in Bangladesh, due to the power of personal recommendations in driving sales.²³

22. CLASP (2019). The Appliance Market in Bangladesh: Lessons Learnt from Field Visits and Interviews with Retailers.

23. McKinsey & Company (2010). A new way to measure word-of-mouth marketing.

CONCLUSIONS & KEY FINDINGS

Telephone survey results from over 1,600 purchasers confirm the high impact potential of super-efficient off-grid fans in Bangladesh. Data show significant strides in productivity, health, and energy access at the household level, and opportunities for fans to play a large role in broader market creation efforts for energy-efficient off-grid appliances.

PRODUCTIVITY



Households reported significant productivity gains after purchasing a solar fan.

With improved access to cooling, people can work longer and are able to move their work indoors when necessary. Women and the elderly are the main beneficiaries of off-grid fans due to their role they play in performing most household chores.

ENERGY ACCESS



Super-efficient off-grid fans increase energy access, reduce the cost of electricity, broaden energy reliability, and enable the use of other appliances.

Depending on the level of access households had prior to purchasing a fan, and whether the fan was bought with a PV system or not, observed impacts ranged from gaining first-time access through to improved reliability, and a reduction in costs. Arguably the most significant improvement experienced by households was that by purchasing fans with a PV system, families are now able to use modern lighting and other basic appliances.

HEALTH



Off-grid fans reduce exposure to pollution and disease-carrying insects, leading to improvements in health and well-being.

Respondents who purchased a fan observed a reduction in sweating and dehydration, both of which are correlated with the increased risk of serious health problems. Users also noticed a reduction in mosquitoes, which can spread serious diseases such as dengue fever and malaria. Finally, respondents often mentioned a reduction in dust within households and improved ventilation, further reducing the number of harmful pollutants and allergens.

MARKET CREATION FOR SOLAR TECHNOLOGIES



Finally, off-grid fans should be included as part of a larger strategy to build markets for energy-efficient solar appliances.

A large majority of fans buyers were happy with the performance and many plan to buy another appliance. Additionally, many of the people also recommended buying the device to additional people.



REFERENCES

Anderson, J. (2017). National Survey and Segmentation of Smallholder Households in Bangladesh: Household Level Data. Consultative Group to Assist the Poor.

Broad, W. (2013). A Low-Tech Mosquito Deterrent. The New York Times.

Cain, M. (2010). The Activities of the Elderly in Rural Bangladesh. Population Studies. Vol 45, no. 2, 1991, pp. 189–202.

Central Intelligence Agency. (2019). South Asia: Bangladesh — The World Factbook.

CLASP. (2017). Off-and-Weak-Grid Appliance & Equipment Technology Summaries.

Clean Cooking Alliance. (n.d.).

Dasgupta, S., Huq, M., Khaliqzaman, M., Pandey, K. and Wheeler, D. (2006). Who suffers from indoor air pollution? Evidence from Bangladesh. Health Policy and Planning. Vol 21(6), pp.444-458.

Eckstein, D., Hutfils, M. and Wings, M. (2019). Who Suffers Most from Extreme Weather Events? Weather-related Loss Events in 2017 and 1998 to 2017. Global Climate Risk Index.

Energypedia. (n.d.). Bangladesh Energy Situation.

Heal, G., Park, J. (2014). Feeling the Heat:

Temperature, Physiology & the Wealth of Nations. National Bureau of Economic Research.

Graff Zivin, J., Neidell, M. (2014). Temperature and the Allocation of Time: Implications for Climate Change. Journal of Labor Economics, University of Chicago Press. Vol. 32(1), pp. 1-26.

McKinsey & Company (2010). A new way to measure word-of-mouth marketing.

McSweeney, C., New, M. & Lizcano, G. (2010). UNDP Climate Change Country Profiles: Bangladesh.

Mosquito.org. (n.d.). FAQ - American Mosquito Control Association.

Savage, S. (2018). Deadliest year for dengue fever in Bangladesh as cases explode in Dhaka. The Guardian.

World Bank Group. (2019). Energy Access Diagnostic Report

Based on the Multi-Tier Framework – Bangladesh.

World Bank Group. (2016). Bangladesh: Building Resilience to Climate Change.



**EFFICIENCY
FOR
ACCESS**

CONTACT US

 efficiencyforaccess.org

 info@efficiencyforaccess.org

 [@EforA_Coalition](https://twitter.com/EforA_Coalition)