

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

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EFFICIENCY FOR ACCESS COALITION



This report summarises telephone survey results from 1,600 customers to understand the impact and socio-economic value of super-efficient off-grid 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 (EforA). EforA is a global coalition working to promote high performing appliances that enable access to clean energy for the world's poorest people. It 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.

EforA is jointly coordinated by CLASP, an international appliance energy efficiency and market development specialist not-for-profit organisation, and the United Kingdom's (UK) Energy Saving Trust, which specialises in energy efficiency product verification, data and insight, advice, and research.

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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 in Bangladesh have risen considerably over the last 60 years. 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 in Bangladesh will therefore be critical to ensuring safe households, workplaces, and communities.

Despite their popularity, the distribution of fans in South Asia is not uniform. Urban markets in hot and humid climates see penetration rates for fans 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%.⁴ 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.⁵

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 energy-efficiency of BLDC motors. These improvements may further inspire 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.⁶ This report seeks to fill important knowledge gaps by assessing the socio-economic impacts of super-efficient off-grid fans in Bangladesh. Data for this report were collected through a RBF mechanism led by CLASP that allocates incentives to the Winners and Finalists of the Global LEAP Awards.⁷ The RBF mechanism in Bangladesh supported sales of 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

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. World Bank Group (2019). Energy Access Diagnostic Report Based on the Multi-Tier Framework – Bangladesh. [online] Available at: <https://energydata.info/dataset/9754e175-4eb7-455f-8439-73716553ca9e/resource/70c5550d-0c8e-437a-b5d4-d8708f57def4/download/bangladesh.pdf> [Accessed 22 Apr. 2020].

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

7. 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

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.

dataWhiz then cleaned the collected data, eliminating incomplete or incoherent answers. Out of the 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 sample respondents were male. The average household size of the sample was 5.3 people, with two-thirds of the sample falling in the range of three to six people per household. Thirty-eight percent of all respondents

Figure 1: Distribution of the sample by division

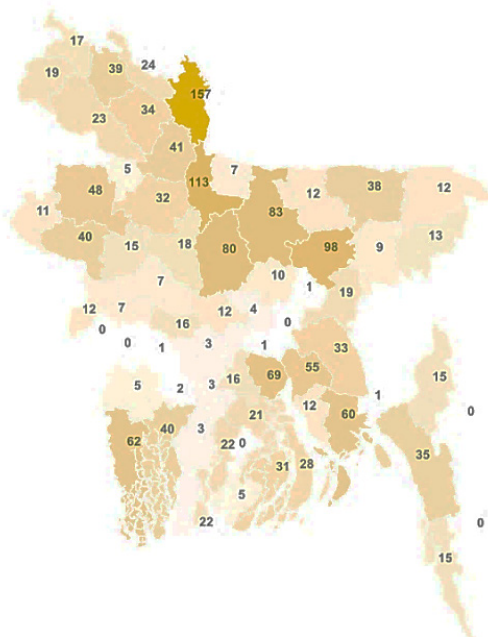
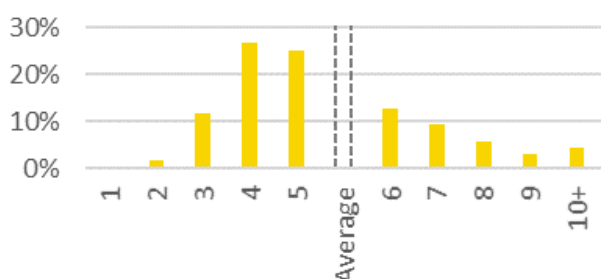


Figure 2: Distribution of household sizes in the sample



Source: Bangladesh Impact Survey



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 super-efficient off-grid fan at home, rather than at their job. Only 28% of respondents indicated their household had used electricity from the grid for lighting before they purchased a fan.

FINDINGS

Survey data overwhelmingly support assumptions about the positive impacts of super-efficient off-grid fans and their ability to catalyze 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 productivity⁸ 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.⁹

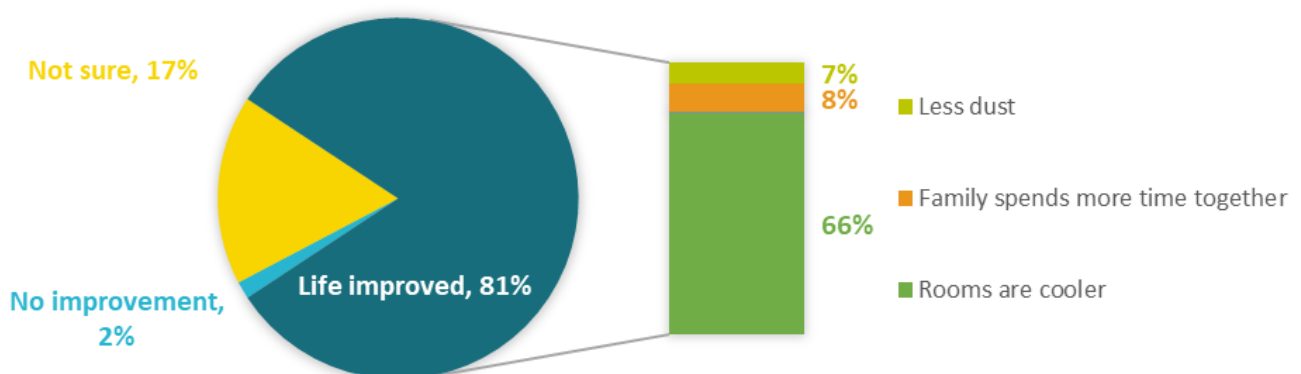
Low- and middle-income countries often experience the harshest climates and are most vulnerable to the adverse effects of climate change. As a result, their relative economic position is likely to worsen as the planet warms.¹⁰ Cooling technologies have the potential to mitigate the consequences of extreme 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 their greater reliance on physical manufacturing work and labor-intensive agriculture. Research suggests that physical workers work one hour less on days that surpass 29 degrees Celsius – commonplace temperatures for nine months of the year in Bangladesh.¹¹ High temperatures affect workers' abilities to work 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 their super-efficient off-grid fan 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

Figure 3: Respondents reporting improvements in quality of life



Source: Bangladesh Impact Survey

8. The ability to work longer hours.

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

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

11. 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.

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

work longer hours, and complete a range of activities indoors. In Bangladesh, the elderly, children, and women often work from home.¹² 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.

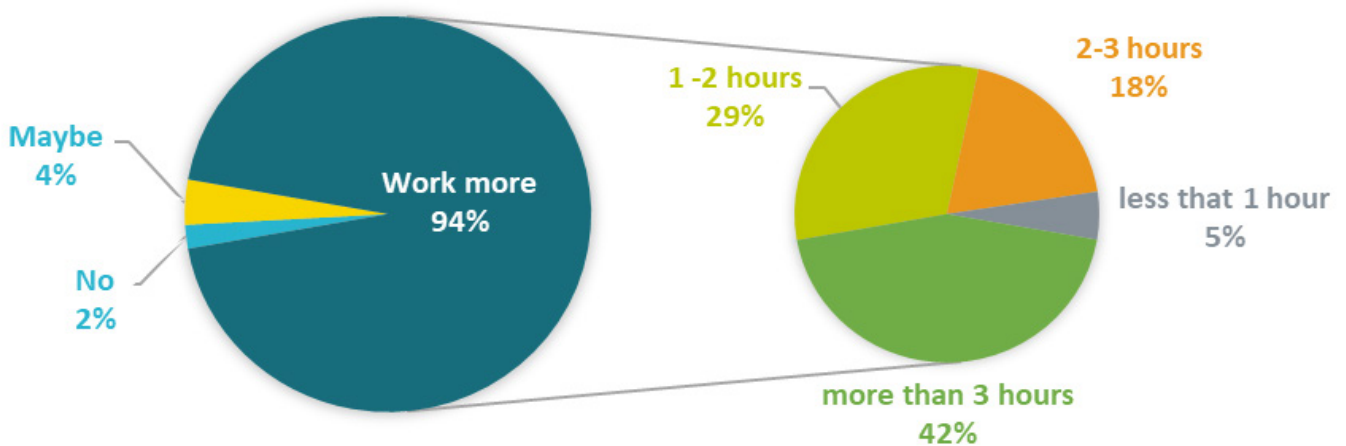
Productivity gains—field observations

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 super-efficient off-grid fan was 2 hours and 20 minutes a day.¹³ The reported additional

productive time conforms with research linking heat reduction to productivity.¹⁴ Forty-four percent of survey respondents said that they enjoy three hours or more each day of extra productive time with their super-efficient off-grid fan, suggesting that most families feel very strongly about the impact of their fan on productivity.

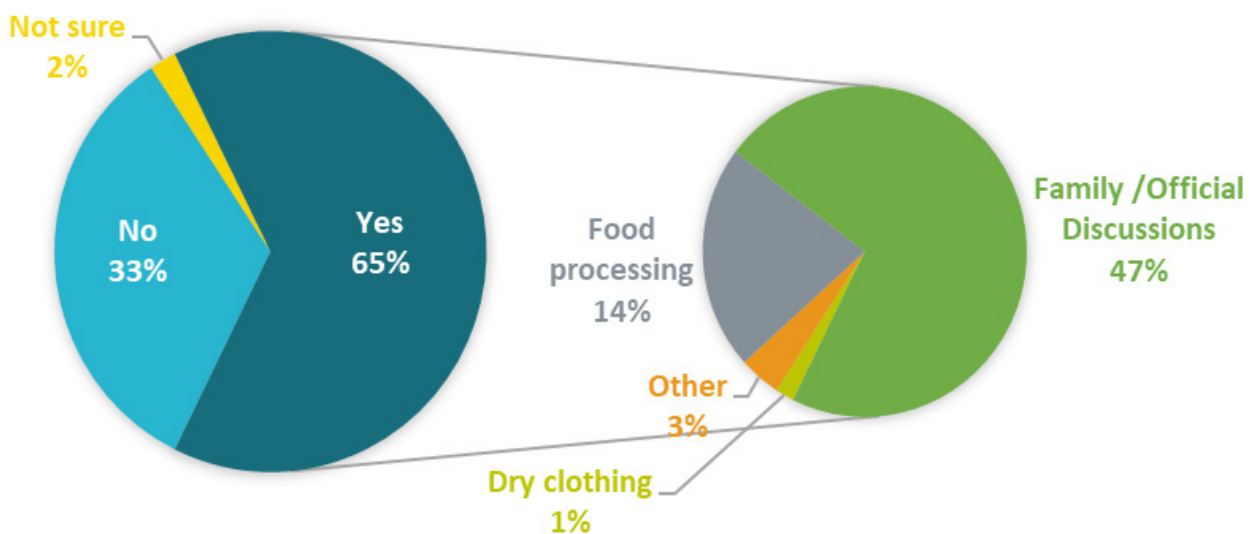
Sixty-five percent of survey respondents stated that their super-efficient off-grid fan allows their family to shift activities like discussions and food processing indoors. In the case of rural Bangladesh, where many families live in mud houses that are too hot for indoor work, the ability to move work 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.

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

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

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

Three percent of the sample used their super-efficient off-grid fan for business purposes. Survey results show a positive impact of fans on business productivity similar to household 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, however, is not very robust considering the small sample size.

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 users by removing warm and humid air and replacing it with drier air that helps to reduce one's body temperature.¹⁵

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.¹⁶ 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.¹⁷ Similarly, super-efficient off-grid fans also help reduce the prevalence and spread of mold allergens by reducing humidity. Mold allergens 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, life-threatening diseases like dengue fever and malaria. As mosquitoes are relatively weak fliers, fans are a simple defense against them.¹⁸ Fans also help disperse CO₂ and other human emanations, which insects use to localise people.¹⁹ While further research is needed to confirm the impact of using super-efficient off-grid fans to reduce one's odds of contracting a mosquito transmitted disease, lower exposure to insects from fan use is likely to reduce one's risk.

Expected impact on the health of household members

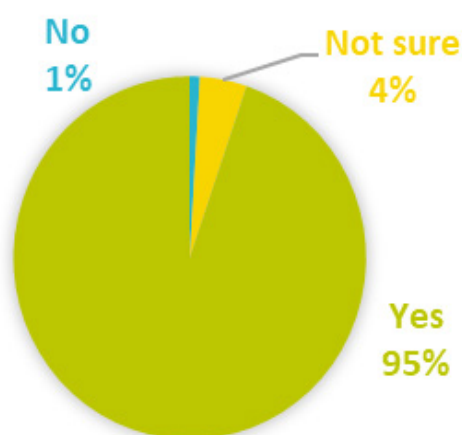
We predicted that super-efficient off-grid fan users would report improvements in ventilation, reduced indoor temperatures, better health, and a reduction in mosquito populations as a result of using their fan. The survey included questions on observable symptoms related to diseases, respondents' health

awareness, and the prevalence of mosquitoes in places where super-efficient off-grid fans are used.

Health benefits: Field observations

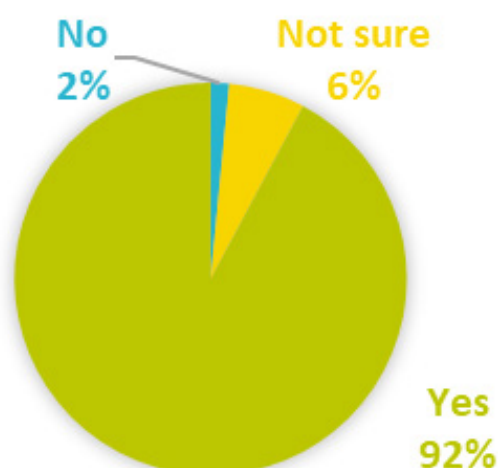
Ninety-two percent of respondents noticed a positive impact of super-efficient off-grid fans on the health of their families. Respondents noticed that they felt less dehydrated and that they sweat less, both strong indicators of the overall improvement of health and reducing the risk for serious health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

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

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

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

17. 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.

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

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

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

Eighty-one percent of respondents stated that their super-efficient off-grid fan 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 decades, underscoring the health benefits of widespread fan use.¹⁰

Improved energy access for households

Availability of cheaper and more energy-efficient appliances translates to better access to energy services. With a relatively low levels of grid penetration²¹ and frequent and prolonged blackouts, super-efficient off-grid fans are a step toward better access to energy services in Bangladesh. Super-efficient off-grid fans can run independently from the electric grid when coupled with a PV panel or battery backup, helping users who live far away from the grid or suffer from low grid reliability gain access to a more dependable power supply.

The 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.

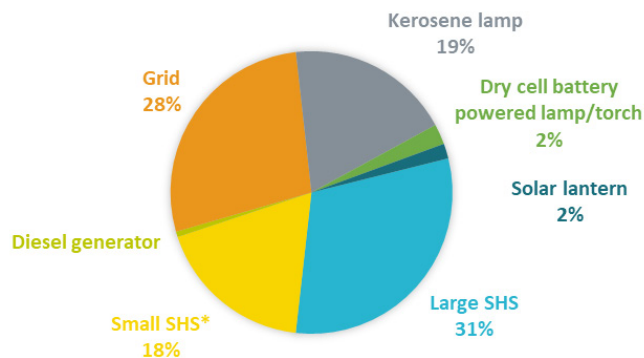
Nearly 45,000 households who bought a fan with a SHS gained access to modern lighting, which is arguably the most basic criteria when assessing access to energy services. Households were asked about their main source of electricity for lighting prior to buying the fan. Twenty-five percent of respondents gained access to modern energy services for the first time with the purchase of their fan, allowing many households to upgrade from dangerous, 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

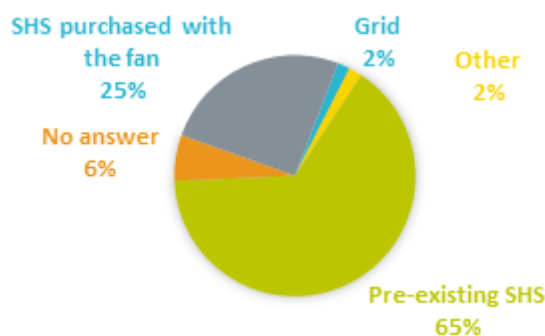
We predicted the purchase of a super-efficient off-grid fan would help households enjoy higher reliability of the appliance, lower the cost of use, and serve as a potential gateway to greater appliance usage. There are multiple, context-dependent, channels through which new owners of a super-efficient 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

Figure 8: Sources of electricity used for powering fans by home users



Source: Bangladesh Impact Survey

Figure 9: Improved energy access for households



Source: Bangladesh Impact Survey

consumption. For others, a super-efficient off-grid fan was expected to become a trigger, incentivising the purchase of a solar unit able to power other appliances. This in turn can reduce household dependence on an unreliable grid, reducing the cost of electricity, curtailing CO₂ emissions, and expanding the range of appliances families used.

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 often becomes a part of a system that significantly improves a household's access to energy. The 25% of the respondents who purchased a SHS with their super-efficient off-grid fan are now able to use a range of previously inaccessible basic appliances. For the 69% of respondents 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 their system's power.

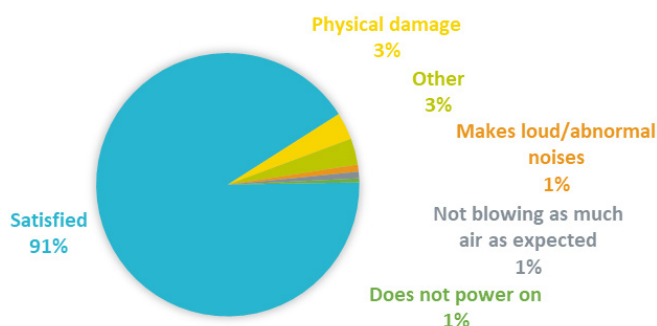
21. Energypedia. (n.d.). Bangladesh Energy Situation.

Market creation for energy-efficient solar technologies

Promoting super-efficient off-grid appliances can accelerate a paradigm shift towards improved energy-efficiency and 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-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 technologies.

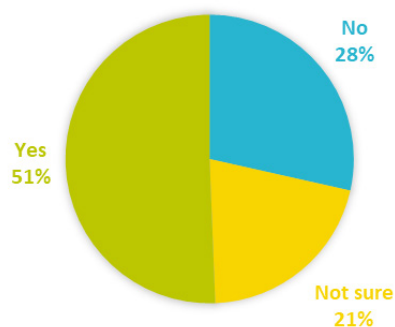
Super-efficient off-grid fans are an appropriate catalyst for other solar technologies in Bangladesh. Fans are widespread across Bangladesh, with penetration levels of 60%.²² Fans are also relatively inexpensive. Early adopters are likely to perceive the associated risk of buying an unfamiliar product to be relatively low. Finally, fans are used by people from a variety

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

of socio-economic backgrounds, suggesting their potential to improve recognition of the technology across a wide range 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 contrast, sellers 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.²³

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. This positive interaction with their appliance may make users more willing to talk about their positive experiences or explore additional appliances available for purchase. Therefore, under the right circumstances, super-efficient off-grid fans may serve as gateway to more advanced and expensive solar appliances, like TVs or refrigerators.

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

Ninety-one percent of respondents reported that their super-efficient off-grid fan performed as expected. For the remaining 9% of respondents, the concerns were related to some form of physical damage. Interviews suggest respondents' concerns were 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) with their solar technology.

Over 50% of respondents reported that they need and other super-efficient off-grid fan and intend to purchase one. 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 respondents claimed they had recommended a super-efficient off-grid fan to another person. These positive experiences may have a significant impact on sales in Bangladesh, due to the power of personal recommendations in driving sales.²⁴

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

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

24. 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 gains in productivity, health, and energy access at the household level, and reveal opportunities for fans to play a large role in broader market creation efforts for super-efficient off-grid appliances.

PRODUCTIVITY



Households reported significant productivity gains after purchasing a super-efficient off-grid 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 respondents had prior to purchasing a super-efficient off-grid fan, and whether the fan was bought with a PV system or not, observed impacts ranged from gaining access to modern energy services for the first time to improved reliability and energy cost reductions. 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



Super-efficient 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



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

A large majority of respondents were happy with the performance of their super-efficient off-grid fan. Many plan to buy another appliance or recommend a super-efficient off-grid appliance to others.



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.
- World Bank Group. (2019). Energy Access Diagnostic Report Based on the Multi-Tier Framework – Bangladesh.



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