MWANGAZA MASHINANI PILOT PROJECT ENDLINE EVALUATION REPORT

Evaluation of the Mwangaza Mashinani pilot project in Kilifi and Garissa counties, Kenya

Volume I: Endline evaluation report

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ACRONYMS

ARI	Acute respiratory infection
ATT	Average treatment effect on the treated
BCC	Behaviour change communication
BWC	Beneficiary Welfare Committee
CC	Community champion
CT-OVC	Cash Transfer for Orphans and Vulnerable Children
DSA	Directorate of Social Assistance
E4I	Energy4Impact
GoK	Government of Kenya
ITT	Average treatment effect on those intended to be treated
KEQ	Key evaluation question
KOSAP	Kenya Off-grid Solar Access Project
KSH	Kenyan shilling
MIS	Management information system
MLSP	Ministry of Labour and Social Protection
MoE	Ministry of Energy
MTF	Multi-Tier Framework
MVP	Millennium Village Project
OECD-DAC	Organisation for Economic Co-operation and Development's Development Assistance Committee
OP-CT	Older Persons' Cash Transfer
OPM	Oxford Policy Management
POC	Point of contact
PWSD-CT	Cash Transfer for Persons with Severe Disabilities
Sida	Swedish International Development Agency
SMD	Standardised mean difference
SPS	Social Protection Secretariat
ToC	Theory of change
UNICEF	United Nations Children's Fund
VfM	Value for money

EXECUTIVE SUMMARY

The Mwangaza Mashinani pilot project

Intervention context

In December 2018, the Government of Kenya (GoK) launched its National Electrification Strategy to achieve its goal of universal energy access by 2022. Kenya has seen rapid increases in electrification over the past few years, increasing grid access for Kenyan households from a rate of 25% in 2011 to 64.5% in 2018, according to Power Africa (2018). Despite this, there remain large inequities in electricity provision, with close to 95% of the population not having access to electricity in rural parts of the country (Willcox *et al*., 2015). While Kenya has a rapidly growing and innovative solar market, most of the large solar suppliers are concentrated in the western and central parts of the country, with limited supply networks in rural areas (Energy4Impact *et al*., 2018). Further, solar devices are relatively expensive products and even when products are available the poorest households will remain excluded due to the issue of product affordability.

The GoK has made significant progress in building the National Safety Net Programme, which has expanded cash transfers to the most vulnerable segments of the population. In 2020, the GoK transferred Kenya shillings (KSH) 4,000 (approximately US$ 37) to over 1 million households on a bi-monthly basis. Over the next five years, the GoK has prioritised the 'cash plus' agenda, based on the assumption that the impacts on households' well-being are greater if cash transfers are complemented and linked with other interventions and programmes. The 'cash plus' agenda hopes to help households to diversify their incomes, improve access to essential services, such as energy services, and improve their well-being in terms of education and health outcomes, among others.

Object of the evaluation

Oxford Policy Management (OPM) has been contracted by the United Nations Children's Fund (UNICEF) to conduct an independent evaluation of the GoK's Mwangaza Mashinani pilot project. The Mwangaza Mashinani[1] is an innovative pilot project that is designed to enhance energy access for the most vulnerable segment of the Kenyan population, to increase their well-being in terms of health, education, and livelihoods, with a particular focus on women and children. This is expected to be achieved by:

- households reducing their use of kerosene and/or candles for lighting, resulting in a reduction in indoor air pollution and fire hazards, and, ultimately, a reduction in the prevalence of acute respiratory infections (ARIs), burns, and eye irritation;
- children increasing the number of hours that they spend studying at night by using solar lighting, resulting in improved educational outcomes; and
- households using the solar device to increase productive activity, diversify livelihoods, and reduce net energy expenditure, resulting in an increase in household income.

Additionally, the pilot project seeks to develop markets for solar energy by increasing the penetration of solar products to previously underserved communities. This is expected to be achieved by providing incentives to participating solar suppliers to extend their networks into hard-to-reach areas by incorporating a de-risking mechanism into the project. The project is offering a guarantee to suppliers that it will pay 80% of the value of the device in the event of a household defaulting on their payments.

The pilot project also aims to generate evidence on the impact of solar devices on households' well-being, and to understand how a market for solar devices can be developed in underserved regions.

[1] Mwangaza Mashinani is Kiswahili for 'light at the grassroots'.

The pilot project is designed to address the issue of affordability of solar products for the poorest segment of the population. The first phase of the pilot project targeted 2,000 vulnerable households in selected sub-counties in Kilifi and Garissa. The pilot project provided subsidies, through a bi-monthly cash top-up to households enrolled in the Inua Jamii cash transfer programme who wish to purchase a small solar device for lighting. The purpose of providing cash top-ups (subsidies) to purchase the device, rather than distributing free solar devices, is to foster a sense of ownership of the device among beneficiary households, as well as to avoid introducing distortions into the market for solar devices.

Purpose of the evaluation

The primary purpose of this evaluation is to provide a summative assessment of the impact of the pilot project, and to generate scientifically robust evidence on whether and how the project has had an impact on the quality of life of children and their families in terms of education, health, and livelihoods. The evaluation also has a formative purpose, to improve the pilot project's processes.

Objectives of the evaluation

The primary objectives of the evaluation are to provide: i) an assessment of the relevance of the pilot project with respect to the needs of vulnerable households in Garissa and Kilifi; ii) an assessment of the impact on beneficiary households attributable to the pilot project, with a focus on women and children; and iii) an assessment of the effectiveness and efficiency of the project implementation process, with a focus on operational lessons and recommendations for Phase 2, scale-up, and sustainability.

Intended audience

This evaluation has been produced for the GoK on behalf of UNICEF and with funding from Sida. The evaluation findings are of relevance to the Ministry of Public Service, Gender, Senior Citizens Affairs and Special Programmes, the Ministry of Energy (MoE), county governments in Kilifi and Garissa, the implementing consortium, and UNICEF. The evaluation findings are also intended to inform the international debate on the role of 'cash plus' programmes in poverty reduction.

Evaluation design and methods

The evaluation takes a theory-based approach, which methodologically guides the evaluation by drawing on the pilot project's theory of change (ToC) to identify the key issues the evaluation should address. A mixed methods research framework was designed to answer the evaluation questions. This comprises the following:

- **A quantitative research study** – to respond to questions regarding effectiveness and impact, and to support answers on relevance. This study is based on a quasi-experimental design and a quantitative household survey, which was implemented through an in-person survey at baseline and endline and a remote phone survey at midline.
- **A qualitative research study** – to respond to questions regarding relevance and effectiveness, and to provide initial indications on sustainability. This study is based on interviews with community leaders, community-based project support structures, and beneficiary households.
- **An implementation review** – to respond to questions regarding the relevance and effectiveness of the pilot project. This study is based on interviews with national-level stakeholders, including the GoK, UNICEF, and the project implementing consortium.
- **A value for money (VfM) study** – to respond to questions regarding efficiency. This study relies on data from UNICEF and the implementing consortium.

Main findings and conclusions

Relevance

Overall, our findings suggest that the Mwangaza Mashinani pilot project's objectives are relevant for the targeted households, solar suppliers, and the GoK. Specifically, the project's aim to improve the affordability of small solar devices is relevant for the targeted households, who are found to lack access to modern energy sources for lighting and for charging mobile phones. Our findings confirm that, even at endline, affordability remains the key constraint on purchasing solar devices for these households.

The project also aims to develop markets for solar energy by increasing the penetration of solar products in previously underserved communities. We find that the de-risking mechanism offered to the solar energy suppliers provides them with a sufficient incentive to explore new remote markets and to expand into underserved regions. We also find evidence of increased penetration of non-project solar devices in the surveyed communities, with a quarter of beneficiary households reporting owning another solar device besides the one supplied by the project. Compared to baseline, we found that a significantly higher number of households that had intended to enrol in the project but did not, and of households in the control sub-counties, own a solar device at endline.

Finally, the project is aligned with the priorities of both the social protection and energy sectors in terms of supporting all Kenyans to live in dignity and achieving universal electrification, respectively.

Effectiveness

The pilot project was able to register, target, and enrol over 2,000 vulnerable households in its first phase, with 1,692 households ultimately purchasing the solar devices. The project was also able to distribute solar devices and to deliver all six cash top-up payments to beneficiaries, including the final payment during the COVID-19 pandemic. However, along the delivery chain, the project has faced a number of challenges, many of which are due to weaknesses in outreach and communication, and, in particular, limited implementation of the behaviour chance campaign (BCC) component. The evaluation findings suggest that while households were aware that two devices were offered through the project, it is not clear that households made an informed selection. Further, we find that households struggled with the repayment process due to a lack of financial literacy or due to challenges using M-Pesa, in many cases requiring support from the village chiefs and community champions (CCs) to facilitate repayments. We also find that, as part of the enrolment process, almost half the households that enrolled in the project paid the commitment fee using money provided by project staff or family/friends.

In addition, the pilot project relies heavily on the Inua Jamii's delivery systems. While we find that targeting for the project was successful, with most households meeting the eligibility criteria, there was also the perception that not all vulnerable households had been included. By targeting beneficiaries of the Inua Jamii, the pilot project targets only vulnerable households that meet the Inua Jamii's categorical targeting criteria, while also inheriting the Inua Jamii's exclusion errors. Given the pilot project's focus on enhancing access to modern energy for vulnerable households in underserved communities, a more inclusive approach to targeting, that covers both Inua Jamii and non-Inua Jamii households, could be better suited to achieving this objective.

The Mwangaza Mashinani pilot project also piggybacks on the Inua Jamii payment systems, including in terms of timing. This means that challenges faced by Inua Jamii beneficiaries in accessing their regular payments are inherited by the project. In particular, payment delays are problematic for the pilot project, as households are not able to make timely repayments to the solar providers, resulting in their lights being switched off.

Impact

At endline, the majority of households are using solar energy for lighting. As a result, the pilot project has had a positive and large impact on households' access to better and more reliable energy for lighting, on their reduced reliance on other more polluting and lower-quality sources of lighting, and on their reduced spending on energy for lighting and charging mobile phones. Awareness of the benefits of solar energy among beneficiary households at endline is extremely high and has improved over time. There is also evidence of market creation effects of the project: the penetration of solar devices in the surveyed treatment and comparison communities has increased markedly over time.

Households use the solar devices on a daily basis, mostly for supporting children's study time, for productive unpaid activities, for charging mobile phones, and for providing light for security and socialisation. The use of the solar devices has also had unintended positive effects on beneficiary households' social well-being, including a better sense of security provided by light at night, staying connected by having charged mobile phones and radios, and improved social capital within communities.

The pilot project has had a positive and significant impact on the number of hours children spend studying outside school, and in particular at home during dark hours. Girls and boys spend equal amounts of time per day studying. The majority use the solar home system to study during dark hours. The pilot project has had a positive and significant impact on children's school attendance and promotion to subsequent academic grades. There is no evidence of an attributable impact on the proportion of children regularly attending school.

Despite an increase in the number of working household members and the number of productive activities households are engaged in over time, there is no evidence that the pilot project has had an attributable impact on these outcomes, or on households' monthly income. At midline, we found a modest positive impact of the project on the number of working members and productive activities. However, this mid-term impact has not been sustained at endline. We also find that, while women are spending more time on productive activities – and specifically unpaid labour – compared to at baseline, and over half are using solar devices to conduct their productive activities during dark hours, there is no evidence that the pilot project has had an attributable impact on how women allocate their time to different activities. Reassuringly, we do not find unintended detrimental impacts on women's time poverty.

While the prevalence of symptoms of eye irritation and burns related to lighting fuel among household members has decreased over time, to reach very low levels at endline, there is no evidence that these improvements can be attributed to the pilot project. Households' cooking habits remain a primary contributor to exposure to indoor air pollution.

Efficiency

In terms of coordination, our findings suggest that the pilot project is well-coordinated at the county level, through the county technical working groups, but that national-level coordination could be strengthened. The pilot project has been implemented using local structures that are also part of the Inua Jamii, and has set up its own structures to embed the project in the communities, although awareness of these structures is limited.

In the evaluation period under review, the VfM performance of the pilot was consistent with the agreed standards for 'good' economy, 'average' efficiency, and 'average' cost-effectiveness. However, the expected VfM performance of the project at scale is on track to be 'good' for all three dimensions, including efficiency and some aspects of effectiveness, provided current performance levels are maintained and a number of specific conditions hold.

In terms of economy, the pilot project has managed to minimise the transaction costs of the cash transfers, as well as operational and staff costs related to UNICEF's activities. However, contractual

services cost more than had been expected. While the project followed sound procurement practices in selecting the solar suppliers, the final cost of the solar products was above the budgeted amount.

In terms of efficiency, the majority of activities have been implemented within budget, although the pilot project allocated more resources to set up and inception activities, as well as implementation, compared to the budget. This was due to delays in the procurement practices and challenges emerging from contextual factors, some unforeseeable. Despite the initial delays, by June 2020 most logframe targets had been achieved. Nonetheless, 22% of enrolled households decided not to purchase the solar device and 30% of beneficiaries did not make repayments for the device regularly.

Finally, the pilot project meets the definition of providing 'average' cost-effectiveness in relation to education and energy. Excluding pilot-related costs, it is estimated that the cost of the project requires US$ 11.40 to be consumed to increase a child's attendance in school by one day. Further, it costs US$ 2.30 to increase a child's study time by one hour at night. In relation to energy use, Mwangaza Mashinani households are benefiting from an average of 3.4 hours of extra energy use per day. The cost-effectiveness indicator suggests that it costs US$ 0.13 for one extra hour of energy using solar devices as an extra source of energy, which is lower than the cost of using mini-grids as an alternative source of renewable energy.

Sustainability

The assessment of sustainability indicates there is a high degree of commitment to scaling up the pilot project by the national government. Stakeholders in the MoE, Social Protection Secretariat (SPS), and Directorate of Social Assistance (DSA) have endorsed the pilot project and are interested in scaling it up. The Kenya Off-Grid Solar Access Project (KOSAP) was widely mentioned as a potential vehicle for scale-up during the implementation review. Solar providers are also interested in exploring new markets.

Evidence at the household level suggests that households would struggle with the costs of maintaining the solar devices or replacing them once they reach the end of their lifespan. Many beneficiary households at endline do not have a fully functioning device. Many households have also experienced maintenance issues with their device and have had to have it repaired, though it is not clear if these are minor or major repairs. Households indicated that they are willing to make minor repairs to their device, but they would struggle with making more substantial repairs or replacing their device if it breaks down, due to affordability concerns.

The solar devices are expensive products for the target market and are highly subsidised by the project in order to 'seed' the market, create awareness, and overcome the issue of affordability. However, it is not clear how consumer affordability would be addressed in a scale-up scenario.

Key recommendations

- The GoK needs to clearly articulate the overarching policy objective of the project in order to determine which ministry, or combination of ministries, will scale it up.
- To achieve the goal of universal access to minimum electric lighting services, the MoE will need to actively address demand-side constraints (e.g. affordability) on accessing off-grid energy.
- The approach of drawing suppliers in to hard-to-reach markets through the project seems to have been effective. This market-based approach is important as regards providing households with access to repair services and spare parts, as well as access to higher-level products in the future.
- It is imperative that a strong communication and engagement strategy is developed to strengthen the processes of communication, outreach, and sensitisation. This would ensure that beneficiaries and other stakeholders are aware of key project processes and resources at their disposal.
- Project messaging should motivate children to use the solar lights to study at night, to strengthen this channel of impact.

- Gender should be explicitly incorporated into all stages of the project's design and implementation. This could be achieved, for example, by following the United Nation's Gender Equality and Social Inclusion framework, to systematically address issues related to gender and inclusion.
- Given the crucial importance of making regular repayments in order to be able to use the solar devices, the project implementers should develop and document contingency protocols to guide implementation in the case of Inua Jamii payment delays.
- There is a need to strengthen the project's monitoring and evaluation processes by developing a monitoring and evaluation framework, improving the accuracy of the data that are collected, and utilising monitoring data to improve the processes of implementation.
- The project design needs to be revised to better support households with the maintenance of devices. Without additional support, the endline findings suggest that there is a risk of mass failure of devices in the next few years (as batteries need replacing), resulting in solar waste.
- The project implementers should revise the ToC to be realistic about what types of socio-economic impacts can be achieved, particularly in relation to health and livelihoods, and to explicitly capture the unintended, positive effects that occur for households in relation to social well-being.

1 INTRODUCTION

UNICEF has contracted OPM to conduct an independent evaluation of the GoK's Mwangaza Mashinani pilot project, which is being implemented in partnership with UNICEF.[2] The pilot project is providing cash top-ups for purchasing solar devices[3] to selected households residing in off-grid communities with school-going children and who are currently enrolled in the Cash Transfer for Orphans and Vulnerable Children (CT-OVC), Older Persons' Cash Transfer (OP-CT), or Cash Transfer for Persons with Severe Disabilities (PWSD-CT) in Garissa and Kilifi counties.[4] The purpose of the pilot project is to generate evidence on the impact of solar devices on households' (particularly women and children's) well-being in terms of education, health, and livelihoods, as well as to understand how a market for solar devices can be developed in underserved regions.

This report is presented in two volumes. Volume I presents the findings and a discussion drawing on all research activities conducted throughout the lifetime of the evaluation and Volume II contains the technical annexes to the endline report. The remainder of Volume I is structured as follows: Chapter 2 provides an overview of the pilot project and context. Chapter 3 details the purpose, objectives, and scope of this evaluation. Chapter 4 presents the evaluation methodology and evaluation questions. Chapter 5 presents the findings from the evaluation, drawing on all of the studies conducted throughout the lifetime of the evaluation. The findings are presented following the OECD Development Assistance Committee (OECD-DAC) criteria of relevance, effectiveness, efficiency, impact, and sustainability. Chapter 6 provides a final assessment of the ToC by looking at which assumptions and impact pathways were upheld and which were not. Chapter 7 summarises the conclusions and lessons learned. Chapter 8 presents a full set of recommendations for the project, UNICEF, and the GoK.

[2] Phase 1 was implemented between December 2018 and June 2020 while Phase 2 has been implemented from April 2020.
[3] The pilot project was designed to have a strong BCC component. However, this was limited in implementation and did not form a core part of the project.
[4] The evaluation focuses only on households enrolled in the CT-OVC or OP-CT, as households enrolled in the PWSD-CT were included in the eligible population as an addition during sensitisation and enrolment, after the baseline had concluded.

2 OVERVIEW OF PILOT PROJECT AND CONTEXT

2.1 Context of the pilot project

In December 2018, the GoK launched its National Electrification Strategy to achieve its goal of universal energy access by 2022 (in line with Sustainable Development Goal (SDG) 7). Achievement of this goal will require densification of the national grid services, expansion of grid services where economically possible, and provision of off-grid energy solutions (such as solar devices and mini-grids) in areas where grid provision is not viable.

Kenya has seen rapid increases in electrification over the past few years, increasing grid access for Kenyan households from a rate of 25% in 2011 to 64.5% in 2018, according to Power Africa (2018). Despite this, there remain large inequities in electricity provision, with close to 95% of the population not having access to electricity in rural parts of the country (Willcox *et al*., 2015). These households typically use kerosene lighting, which comes with high operational costs, provides low-quality light, and can have adverse effects on household members' health and the environment (Rom *et al*., 2017). The UNICEF proposal for the Mwangaza Mashinani pilot project suggests that these areas of the country, representing about 2 million households, could be served by off-grid energy solutions, as extending grid access to remote regions is very costly.

Kenya has a rapidly growing and innovative solar market. However, most of the large solar suppliers are concentrated in the western and central parts of Kenya (Energy4Impact *et al*., 2018). Since the national grid does not fully extend into the northern and eastern parts of the country, they remain underserved in terms of energy access. While solar suppliers exist in larger towns, including Garissa Town and Kilifi Town, their networks rarely extend into more rural parts of the counties. Although the GoK's KOSAP,[5] supported by the World Bank, will create incentives for suppliers to move into remote regions, which will help to increase the availability of solar products in general, the poorest households will remain excluded due to the issue of product affordability.

The GoK has made significant progress in building the National Safety Net Programme, which has expanded cash transfers to the most vulnerable segments of the population. In 2020, the CT-OVC, OP-CT, and PWSD-CT programmes, collectively known as the Inua Jamii, transferred KSH 4,000 (approximately US$ 37) to over 1 million households on a bi-monthly basis. Over the next five years, the GoK has prioritised the 'cash plus' agenda, based on the assumption that the impacts on poverty reduction (SDG1) and households' well-being are greater if cash transfers are complemented and linked with other interventions and programmes. The 'cash plus' agenda hopes to help households to diversify their incomes, improve access to essential services, such as energy services, and improve their well-being in terms of education and health outcomes (SDGs 3 and 4), among others.

2.2 Object of the evaluation: the Mwangaza Mashinani project

The Mwangaza Mashinani pilot project is an innovative pilot project that is designed to enhance energy access for the most vulnerable segment of the Kenyan population in order to increase their well-being in terms of health, education, and livelihoods, with a particular focus on women and children. This is expected to be achieved by:

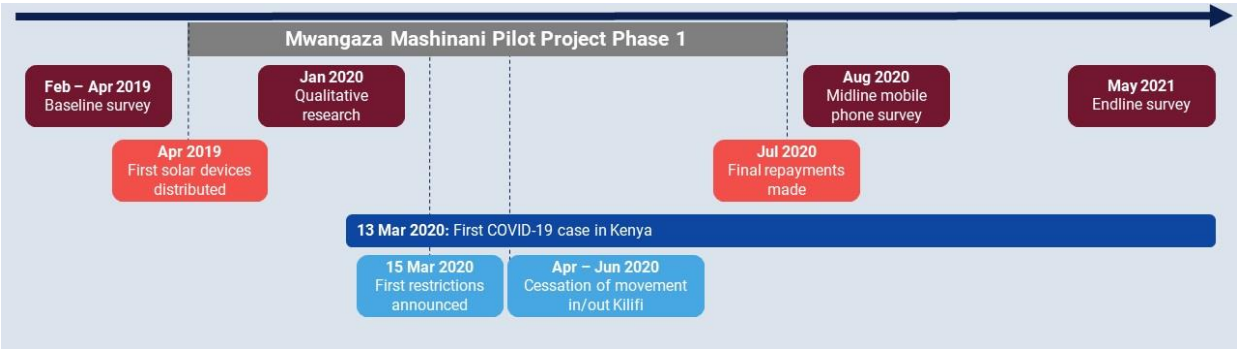
[5] The purpose of KOSAP, which targets underserved counties, is to increase access to modern energy services through four components. The second component, which is of relevance to this project, is to increase access to and ownership of standalone solar devices and clean cooking solutions for households in underserved counties by facilitating and incentivising entry of the private sector into underserved regions. The project does not specifically address issues of consumer affordability.

- households reducing the use of kerosene and/or candles for lighting, resulting in a reduction in indoor air pollution and fire hazards, and, ultimately, a reduction in the prevalence of ARI, burns, and eye irritation;
- children increasing the number of hours that they spend studying at night by using solar lighting, resulting in improved educational outcomes; and
- households using the solar device to increase productive activity, diversify livelihoods, and reduce net energy expenditure, resulting in an increase in household income.

Additionally, the project seeks to develop markets for solar energy by increasing the penetration of solar products in previously underserved communities. It is expected that this will be achieved by providing incentives to participating solar suppliers to extend their networks into hard-to-reach areas by incorporating a de-risking mechanism into the project. The project is offering a guarantee to suppliers that it will pay 80% of the value of the device in the event of a household defaulting on their payments.

The implementation timeline and the timing of research activities is shown in Figure 1.

Figure 1: Timeline of implementation and research



2.2.1 Scale and complexity of intervention

The Mwangaza Mashinani pilot project is designed to address the issue of the affordability of solar products for the poorest segment of the population. The project provides subsidies, through a bi-monthly cash top-up, to households enrolled in the Inua Jamii who wish to purchase a small solar device for lighting. The purpose of providing cash top-ups (subsidies) for purchasing the devices, rather than distributing free solar devices, is to foster a sense of ownership of the devices among beneficiary households, as well as to avoid introducing distortions into the market for solar devices. In addition, the pilot project is designed to piggyback on the Inua Jamii's delivery systems in order to embed the project in the GoK and to improve the efficiency of delivery. This is discussed in Box 1.

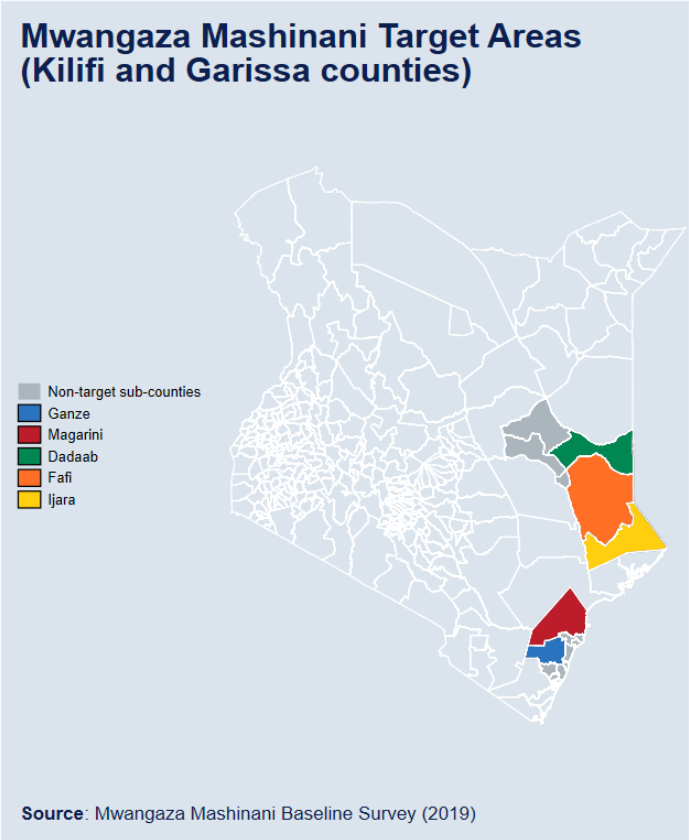
During the first phase of the pilot project, the implementing consortium signed a memorandum of understanding with two solar device suppliers, d.light and Bright Sky Solar Solution (distributors of the BioLite solar device).[6] In order to incentivise their expansion into underserved and hard-to-reach areas in Kilifi and Garissa, the project provided a guarantee mechanism to the suppliers to ensure that they would receive 85% of the value of the solar device in the case of default on the repayments by households.

The first phase of the pilot project targeted 2,000 vulnerable households in selected sub-counties in Kilifi and Garissa (see Figure 2).[7] The sub-counties and locations were selected through a vulnerability

[6] Initially, a third supplier, Green Light Planet, was also part of the pilot project and offered households Sun King solar lanterns. While a small number of households selected this product, Green Light Planet withdrew from the project shortly after it began.
[7] In Kilifi, seven locations in Ganze and Magarini sub-counties were identified as most vulnerable. In Garissa, nine locations across Dadaab, Fafi, and Ijara sub-counties were selected.

assessment,[8] which concluded in December 2018, and which ranked sub-counties and locations in each county based on a number of selection criteria.[9] In each location, eligible households were identified for participation in the project through a verification exercise, which sought to register all households that are part of the Inua Jamii[10] and that had at least one school-going child, were willing to pay a small commitment fee (KSH 250),[11] and did not already have a solar device. Eligible households were then invited to a *baraza*,[12] where they were given information about the project and provided with information on the solar devices that they could choose to purchase through the pilot project. This *baraza* was also attended by households who were not registered during the verification exercise but who met the eligibility criteria. After this, interested households were asked to pay the commitment fee, using their own funds, and were enrolled in the project.

Figure 2: Map of project implementation areas



[8] For details on the methodology and recommendations, see E4I (2018) 'Energy and cash plus pilot project in Kilifi & Garissa counties. Vulnerability assessment report', E4I, Kenya.
[9] In Kilifi, these were: 1) off-grid; 2) geographically remote from infrastructure and services; 3) school performance is poor; 4) enough households enrolled in the CT-OVC programme; 5) high levels of insecurity; 6) high rates of early pregnancy and rape; 7) areas prone to floods; and 8) no livelihoods. In Garissa, the criteria were the same as those applied in Kilifi, with the addition of the prevailing security situation.
[10] The Inua Jamii is the GoK's flagship National Safety Net Programme, covering the beneficiaries of the CT-OVC, OP-CT, PWSD-CT, and the Hunger Safety Net Programme. The objective of the Inua Jamii is to improve the lives of poor and vulnerable citizens of Kenya through regular and reliable bi-monthly cash transfers.
[11] Initially, the commitment fee was KSH 500 but this was lowered to encourage more households to enrol.
[12] *Baraza* refers to a place where public meetings are held.

Box 1: Designed to piggyback on the Inua Jamii

The Mwangaza Mashinani pilot project was designed to piggyback on the Inua Jamii cash transfer system. The purpose of piggybacking on the existing cash transfer system is to support strengthening government systems and to ensure that the project is integrated into the system to enhance sustainability. The piggybacking occurs in a number of ways:

First, the pilot project targets vulnerable households, which is achieved by targeting only beneficiaries of the Inua Jamii. The Inua Jamii is categorically and poverty targeted, using a proxy means test, with the objective of reaching the most vulnerable households that meet the categorical criteria. The Mwangaza Mashinani pilot project chose to piggyback on the Inua Jamii's targeting on the assumption that the Inua Jamii already reaches the most vulnerable households.

Second, the pilot project piggybacks on the GoK's payment systems by using the same partner banks and by transferring the top-ups into beneficiaries' bank accounts. This payment mechanism was selected to reduce the time and money spent by beneficiaries on accessing their money and to minimise the risk that top-up funds are used for consumption.

Third, the pilot project planned to integrate the Inua Jamii's grievance mechanism into the project's operations such that beneficiaries could use the hotline (or other channels of communication) to raise grievances with the project.

Fourth, the pilot project works with the same outreach structures as the Inua Jamii, including chiefs and Beneficiary Welfare Committees (BWCs).

Finally, the pilot project planned to feed into the Inua Jamii's information systems by feeding data from the project into the Single Registry using the complementary module.

Once enrolled, households form part of the Mwangaza Mashinani pilot project for six payment cycles (totalling 12 months in all). During this time, households are required to repay the solar suppliers on a pay-as-you-go basis. Every two months, households receive their Inua Jamii transfer and, at the same time, the cash top-up to be used for the solar device. In each payment cycle, households are asked to withdraw their cash top-up, or transfer it to their M-Pesa[13] account, and to purchase a token from the solar supplier, which activates the solar device for 60 days.[14] The bi-monthly payment schedule is shown in Table 1. Once the number of days for which the light has been paid has passed, the device is switched off and households need to purchase another token to turn the device back on. This process is repeated for six payment cycles and once all six repayments have been made, households own their device and no longer need to pay the suppliers to keep it activated.

Table 1: Repayment amounts, by funding source

Solar device	Source of funds	Cycle 1 (KSH)	Cycles 2–6 (KSH)
d.light	Cash top-up	3,050	2,100
	Household's contribution	250	-
	Total	**3,300**	**2,100**
BioLite	Cash top-up	2,850	2,100
	Household's contribution	250	-
	Total	**3,100**	**2,100**

Note: In the first payment cycle, the cash top-up was higher, to cover the KSH 1,000 deposit for the solar devices (UNICEF paid KSH 750, in addition to the KSH 250 commitment fee). The payment amounts were subsequently aligned for both products. In practice, payments in Cycles 2 and 3 and Cycles 5 and 6 were paid as a lump sum of KSH 4,200.

[13] M-Pesa is a mobile banking service that allows users to store and transfer money through their mobile phones.
[14] In the original design, households also needed to pay a small amount (KSH 200) from their own funds, in addition to the cash top-up, to purchase the token. This was later removed on affordability grounds.

The first phase of the pilot project ended in June 2020. At the time of writing, UNICEF is preparing to support implementation of a second phase of the pilot project, targeting a second cohort of households in Kilifi and Garissa.

2.2.2 Project ToC

The project is expected to improve the well-being of beneficiary households in terms of household members' health, children's education, and household livelihoods by enhancing access to and use of energy for the most vulnerable segment of the population, developing markets for solar energy, and increasing the penetration of solar energy solutions in targeted communities. The solar energy solutions promoted by the pilot project are small solar devices. Table 2 summarises the key expected outcomes of the project based on the ToC. For a full presentation of the ToC, see Figure 47, as well as Annex A in Volume II.

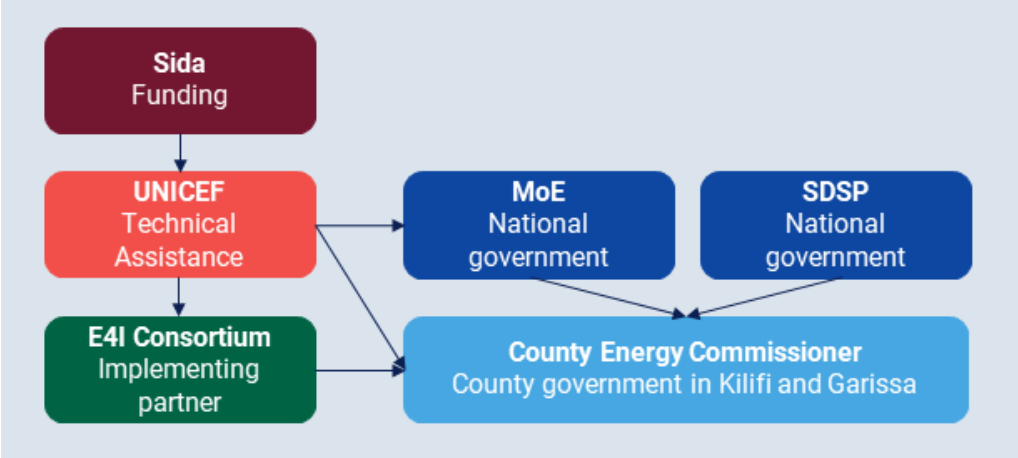
Table 2: Key expected outcomes based on the ToC

Outcomes based on ToC	Impact expected based on baseline findings	Timing of measurement
Household members' health:		
ARI	**No impact expected:** Very low prevalence of ARI in the first place, and continued use of firewood for cooking.	Midline and endline
Eye irritation	**Small, positive impact expected:** Shift to solar devices for lighting but continued use of firewood for cooking.	Endline only
Burns from lighting	**Small, positive impact expected:** Shift to solar devices for lighting, but continued use of firewood for cooking.	Endline only
Children's education:		
Children's study hours	**Positive impact expected:** Majority of time spent studying outside the school is in the dark hours, and there is widespread acknowledgement of the benefit of solar lighting for studying.	Endline only
Household livelihoods:		
Increased livelihood activities	**Small, positive impact expected:** Potential for increase in livelihood activities, but limited scope for achieving this increase given low power output of solar devices. The time use analysis at baseline also shows that around one-third of adult female household members can be considered as time poor. Hence, the potentially negative impact on time poverty will also be assessed at endline.	Midline and endline
Reduced expenditure on energy	**Small, positive impact expected:** Potential for reduction of expenditure on energy, but continued use of firewood for cooking may limit this reduction.	Endline only

2.2.3 Key stakeholders involved

This evaluation was produced for the GoK on behalf of UNICEF and with funding from Sida. The evaluation findings are of relevance for the State Department for Social Protection within the Ministry of Public Service, Gender, Senior Citizens Affairs and Special Programmes, MoE, county governments in Kilifi and Garissa, the implementing consortium (E4I, Somali Aid, and the Busara Center for Behavioral Economics) and UNICEF. The evaluation findings are also intended to inform the international debate on the role of 'cash plus' programmes in poverty reduction.

Figure 3: Stakeholder map



3 PURPOSE, OBJECTIVES, AND SCOPE OF THE EVALUATION

3.1 Purpose of the evaluation

The primary purpose of this evaluation is to provide a summative assessment of the impact of the pilot project, and to generate scientifically robust evidence on whether and how the project has had an impact on the quality of life of children and their families in terms of education, health, and livelihoods. The final evaluation findings aim to assess a proof of concept that project stakeholders can use to advocate for, and facilitate government decision-making around, the scale-up of the intervention.

The evaluation also has a formative purpose, to improve the pilot project's processes. The evaluation evidence needs to facilitate decision-making regarding project implementation and eventual modification of the project's operations for Phase 2, as well as for scale-up and sustainability, by looking in particular at the project's coordination and delivery systems.

3.2 Objectives of the evaluation

The primary objectives of the evaluation can be summarised as follows:

1. To provide an assessment of the **relevance** of the pilot project with respect to the needs of vulnerable households in Garissa and Kilifi.
2. To provide an assessment of the **impact** on beneficiary households attributable to the pilot project, with a focus on women and children.
3. To provide an assessment of the **effectiveness** and **efficiency** of the project implementation process, with a focus on operational lessons and recommendations for Phase 2, scale-up, and **sustainability**.

3.3 Scope of the evaluation

The evaluation assesses the Mwangaza Mashinani pilot project according to the questions laid out in the evaluation framework (presented in Section 4.1.1, with full details provided in Annex B of Volume II), which is structured around the criteria for evaluating development assistance formulated by the OECD-DAC. The evaluation questions are answered in this endline evaluation report by drawing on all evidence generated throughout the evaluation.

This evaluation covers the entire duration of the first phase of the Mwangaza Mashinani project, which was implemented between December 2018 (when targeting took place) until May 2020 (when the final device repayments were made). The evaluation covers all five sub-counties in which the project is implemented.

3.4 Adjustments to the evaluation

Due to the outbreak of the COVID-19 pandemic, the original evaluation plan articulated in the inception report became unviable. As the full implications of the pandemic emerged, it became clear that in-person fieldwork for the endline survey would not be possible in the form originally envisaged. OPM therefore submitted a proposal to UNICEF to revise the evaluation design. The evaluation was subsequently adjusted to include a remote midline survey in mid-2020 (see Section 4.1) in order to achieve two objectives: 1) to ensure that crucial learning that will be useful for the pilot project's

expansion and eventual scale-up is not lost; and 2) to gather timely evidence on COVID-19 to inform UNICEF's, as well as the GoK's and local county governments', responses to the pandemic.[15]

[15] Further details can be found in the Evaluation Adjustment and Redesign Note (April 2020).

4 EVALUATION METHODOLOGY

This chapter sets out the evaluation methodology, with more technical details included in Volume II of the report. In this chapter, we present the key evaluation questions (KEQs) (Section 4.1.1), the mixed methods framework used for the beneficiary-level analysis (Section 4.1.2), the quantitative research component (Section 4.2), and the qualitative component (Section 4.3). The chapter then proceeds, in Section 4.4, with the implementation review, and, in Section 4.5, with the VfM analysis. The methodology chapter concludes with Section 4.6 on risks and limitations, Section 4.7 on stakeholder participation, and Section 4.8 on ethical principles.

4.1 Overarching evaluation framework and design

4.1.1 Evaluation questions

The KEQs answered by this evaluation are as follows:

Relevance:

1. How well is the pilot project suited to the needs of the target population, their community, and private sector solar device suppliers?
2. Is the pilot project ToC internally and externally coherent?

Effectiveness:

3. To what extent have beneficiary households improved their awareness about, and feel a sense of ownership towards, their solar device?
4. How effectively have the operational modalities been taken up by the targeted beneficiaries and private sector suppliers? What are the lessons for scale-up and replication within the National Safety Net Programme?

Impact:

5. To what extent did the pilot project have an attributable significant impact on beneficiary households' access to energy and use of the solar devices for energy services?
6. To what extent and how did the pilot project have an attributable significant impact on the quality of life of beneficiary households, especially children?
7. What have been the unintended and/or unexpected outcomes of the pilot project?

Efficiency:

8. What have been the strengths and weaknesses of the coordination process among key stakeholders involved in the implementation of the pilot project? What are the lessons for scale-up and replication?
9. What have been the strengths and weaknesses of the engagement of community structures and leaders in the implementation of the pilot project? What are the lessons for scale-up and replication within the National Safety Net Programme?

Sustainability:

10. How well are factors that are likely to affect the sustainability and scalability of the pilot project addressed?

The full evaluation matrix can be found in Volume II, Annex B.

4.1.2 Mixed methods approach

This evaluation has been designed in line with the 2016 United Nations Evaluation Group Norms and Standards and is guided by a theory-based approach, which draws on the project's ToC (see Chapter 6 and Volume II, Annex A) to identify the issues the evaluation should address. Through this theory-based approach, the evaluation aims to unpack the ToC causal chain leading from assumptions to impact (or lack thereof), to provide a better understanding of why change happens (or not).

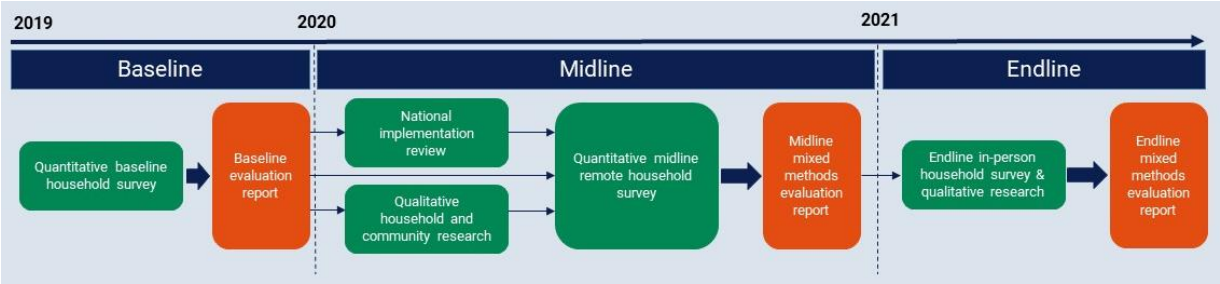
The first step in designing this study was the formulation of KEQs. The KEQs were organised together with detailed sub-questions and indicators in an evaluation matrix according to the five overarching OECD-DAC criteria of relevance, effectiveness, impact, efficiency, and sustainability (see Volume II, Annex B – Evaluation matrix).

A mixed methods research framework was designed to answer the questions articulated in the evaluation matrix. Broadly, this framework combines four methodologies:

- **A quantitative research study** – to respond to questions regarding effectiveness and impact, and to support answers on relevance and sustainability. This study is based on a quasi-experimental design and a quantitative household survey, which was implemented through an in-person survey at baseline and endline, and remotely through a mobile phone survey at midline (see Section 4.2).
- **A qualitative research study** – to respond to questions regarding relevance and effectiveness, and to provide initial indications of sustainability.[16] This study is based on interviews with community leaders, community-based project support structures, and male and female household members (see Section 4.3).
- **An implementation review** – to respond to questions regarding the relevance and effectiveness of the project. This study is based on interviews with national-level stakeholders, including the GoK, UNICEF, and the implementing consortium (see Section 4.4).
- **A VfM study** – the objective of this research study is to respond to questions regarding efficiency. It relies on data from UNICEF and the implementing consortium (see Section 4.5).

Figure 4 presents an overview of how the different research methods are sequenced as part of the evaluation timeline, which was revised and adjusted in response to the challenges posed by COVID-19 (see Section 3.4). At the beneficiary level, the initial findings emerging from the quantitative baseline survey were used to inform the sampling approach and research focus of the qualitative study at the household and community levels, which in turn fed into the design of the quantitative midline survey. This meant that the midline survey included indicators that we aimed to integrate with qualitative evidence, especially in regard to the effectiveness of the project's operations and the efficiency of its engagement with the local community. The comprehensive set of midline findings then informed the design of the quantitative survey tools, as well as the broader research scope of the endline analysis.

Figure 4: Sequencing of quantitative and qualitative research methods



[16] While the qualitative study was originally planned to respond to questions related to impact, due to the timing of the qualitative research, and the fact that the second payment cycle was delayed, we could not elicit qualitative findings on impact. The endline stage of the evaluation did not include further qualitative research, for budget reasons.

Mixing data in practice

Evidence from the four studies was first analysed by methods and sector specialists. Draft findings from each of these studies were drawn up by each specialist team and shared with the wider evaluation team as they emerged. Given that each round of data collection and analysis was staggered across the evaluation cycle, the quantitative and qualitative research teams met several times to both keep abreast of the evidence as it developed and ultimately to build a shared evaluative narrative. In order to write this report, research teams worked together to share findings and then proceeded to write up answers against each evaluation criterion. Each of the findings sections has a lead author and a supporting author, based on the relevant methods used to answer the evaluation questions, but the findings are mixed in each section and the overall conclusions have been drawn based on this mixed methods analysis.

4.2 Quantitative component

The objective of the quantitative impact evaluation is to determine whether the Mwangaza Mashinani pilot project has had an impact on its beneficiaries, and to quantify the scale of any impact detected. This estimation of impact is carried out within the context of a quasi-experimental design. The impact estimates produced at endline and discussed in this report are based on quantitative data collected via an in-person household survey, which represents the second follow-up to the baseline survey after the remote midline mobile phone survey (see Figure 1 for a summary of the evaluation timeline).

The final follow-up and endline stage of the evaluation investigated the full range of potential effects of the pilot project, as agreed in the inception phase of the evaluation. From a quantitative perspective, the endline evaluation analysis has the following three objectives:

1. To provide **descriptive trends** of changes in indicators of interest for the pilot project target population, between baseline and endline (including midline, when relevant).
2. To provide a **descriptive picture** of the pilot project's achievements after two years of implementation in terms of beneficiaries' sense of ownership and devices' durability, together with a focus on some unintended positive effects of the pilot project on beneficiaries.
3. To provide a **measure of the impact** on outcome indicators of interest at the beneficiary level that is directly attributable to the Mwangaza Mashinani pilot project.

Specifically, impact is measured through propensity score matching on indicators related to the following impact areas agreed at inception, and covered by the endline survey:

- **Energy:** Proportion of households using kerosene or paraffin for lighting last month; total household expenditure on all lighting sources last month; total household expenditure on charging mobile phones last month.
- **Child's time use**: Number of hours per day spent studying outside school; number of hours per day spent studying at home at night.
- **Education**: Proportion of children attending school; proportion of children regularly attending school; proportion of children promoted to next grade.
- **Livelihoods**: Number of working household members; number of productive activities; number of productive activities started in the last year; proportion of activities conducted at home; total household income, including remittances.
- **Women's time use**: Number of hours per day spent on productive activities; number of hours per day spent on productive activities at home at night; number of hours per day spent on leisure activities; proportion of women who are time poor.
- **Health**: Proportion of household members with symptoms of eye irritation in last month; proportion of household members with burns related to lighting fuel in last six months.

Details on the impact analysis, including the propensity score matching approach, the results of the balancing tests, and the impact estimates for each impact indicator, are provided in Volume II, Annex E.

4.2.1 How to read the quantitative results in this report

Descriptive findings

Descriptive trends are presented in this report for a range of indicators of interest pertaining to the outcome and impact areas identified using the pilot project's ToC, and on which evidence was gathered through the endline survey, and the mobile phone survey at midline. This pre/post trend analysis looks at the evolution between baseline and endline of key outcomes for treatment households. While for some indicators data were collected at all three points in time over the course of the evaluation, for a number of indicators data were only collected at baseline and endline due to constraints (e.g. overall length of the questionnaire) associated with the remote survey mode at midline. In addition, a cross-sectional analysis focusing on the description of indicators at endline aims to provide an idea of the achievements and sustainability of the intervention, focusing on beneficiaries' sense of ownership and the devices' durability, as well as on some unintended positive effects associated with the pilot project.

Descriptive endline findings are presented for the 567 treatment households interviewed at endline in Kilifi and Garissa,[17] and, where relevant, the corresponding estimates at baseline and midline are presented to assess the trends over time. Throughout the report, descriptive findings are presented for the treatment sample as a whole and are also disaggregated across categories of interest, such as the location of the household (i.e. county), the gender of the household head or household member, and the cash transfer programme in which the household is enrolled. This disaggregation analysis is informed by the way in which the sample is structured across strata (see Annex C in Volume II of the baseline report).

These quantitative descriptive findings are presented graphically. The sample size for different indicators varies depending on the analysis target sub-sample, which is specified in the subtitle of each graph. The size of the sample upon which the analysis is conducted is reported in the notes at the bottom of each graph. For some of the outcome and impact indicators, the graphs display disaggregated results over time, with 95% confidence intervals showing where differences between baseline, midline, and endline estimates for each group are significant (e.g. Figure 15 in Section 5.4.1). Differences are considered to be statistically significant when the confidence intervals are not overlapping. When in the text we refer to differences between sub-groups that are significant, those are statistically significant at the 5% level or lower, while weakly significant differences are those statistically significant at the 10% level.

Detailed statistical tables for the treatment group are presented in Volume II, Annex I.

Impact estimates

For each impact area, two sets of results are presented in this report: the average treatment effect on the intent to treat (ITT), and the average treatment effect on the treated (ATT):

- ITT: Impact is measured across all households that were originally registered for the pilot project and included in the treatment group at baseline, regardless of whether or not they actually

[17] In total, 1,114 households were interviewed in the treatment and comparison groups at endline. However, as was done in the evaluation baseline and midline reports, the endline descriptive findings are only presented for the treatment group (n=567). This is because a straight comparison of treatment and comparison descriptive statistics is not robust and can be misleading. By design, the two groups are not expected to be comparable, simply because of the sampling strategy adopted. In a quasi-experimental design, the comparison group only fulfils the role of constructing a counterfactual to the treatment group to determine whether any impact detected on outcome indicators is directly attributable to the treatment under evaluation.

received the solar devices. In more technical terms, the ITT covers every household that is surveyed in areas defined as treatment areas (according to the implementation plan) and ignores non-compliance or other factors that may prevent households from being treated. In the ITT analysis the impact estimates provide a measure of the effect of being offered, rather than actually receiving, the treatment, and are generally more conservative compared to the analysis of impact on observations that are all equally treated.

- ATT: Impact is measured only for those households that were actually enrolled in the pilot project and that received the solar device. In more technical terms, the ATT is indicative of the expected causal effect of the pilot when its constituent parts reach its intended beneficiaries. The ATT impact estimates are thus biased towards a sub-set of the population that may have been better placed to receive the intervention, and cannot be seen as representative of the overall impact of the pilot. Our investigation of this bias suggests that the primary factors influencing the enrolment are location, gender of household head, and type of cash transfer received. Specifically, more eligible and registered households in Kilifi were enrolled in the pilot than in Garissa, and more female-headed households and CT-OVC beneficiaries were enrolled (see Volume II, Annex D for more details).

Impact estimates are also presented graphically, with one graph per impact area for the ITT estimates and, where relevant, another graph per impact area for the ATT estimates (e.g. Figure 30 and Figure 31 in Section 5.4.2). Each graph shows point estimates for the average treatment effect on outcome indicators and 95% confidence intervals. The confidence intervals indicate that the probability that the true treatment estimate will fall within this area is 95%. When the confidence intervals of such estimates do not overlap with zero, this is an indication that this treatment effect is truly different from zero. A zero value is indicated using a red line in the graphs.

For impact indicators based on proportions (e.g. the proportion of children attending school), the estimates of treatment effects are given as percentage point changes. For impact indicators that are not proportions, the estimates of treatment effects are given in units, as per the unit the indicator is defined in relation to (e.g. in KSH for household income and in number of household members for the indicator on working members per household).

Impact estimates are found in Section 5.4 of the present Volume I. Further details on ITT, ATT, and the results of the impact estimation are presented in Volume II, Annex E.

4.2.2 Sample achievement of the endline survey

Given the longitudinal nature of the evaluation, the same baseline households were tracked and re-interviewed at both midline and endline to create a panel of surveyed households. At endline, the quantitative survey respondents are members of the households that were successfully interviewed for the baseline survey and then again successfully traced and interviewed for the endline survey. The final endline quantitative survey sample achievement was 94%, thus entailing an extremely low attrition rate of 6% over the two years of the evaluation.[18] This also represents an improvement from midline, for which the sample achievement was 80%. The higher attrition rate at midline was mainly due to the remote survey mode, which relied on survey respondents having a mobile phone as well as phone connectivity during the survey. The final quantitative survey sample achievement at endline is shown in Table 3, including the distribution by evaluation group and county. As can be seen, 1,114 households were successfully reached at endline.

Table 3: Final endline sample (target and actual)

[18] The attrition rate was higher in Garissa as a greater number of households could not be found at the time of the endline survey. In most cases, this was due to a household relocating outside the bounds of the survey location either temporarily – as many households are pastoralist – or more permanently due to the security situation in the county.

County	Target	Complete at endline	Completion rate (%)
Treatment	**600 (318)**	**567 (325)**	**94.5**
Kilifi	387 (220)	378 (225)	97.7
Garissa	213 (98)	189 (100)	88.7
Comparison	**586 (312)**	**547 (296)**	**93.3**
Kilifi	373 (206)	366 (208)	98.1
Garissa	213 (106)	181 (88)	85.0
Total	**1,186 (630)**	**1,114 (621)**	**93.9**

Note: the number of female-headed households is indicated in brackets.

Volume II, Annex C provides further details on the sample achievement of the endline survey. Additionally, the sampling strategy adopted to select the sample at baseline, as well as the full technical details concerning the sampling frame, sampling weights, and baseline sample distribution, are presented in detail in the evaluation baseline report.[19]

4.3 Qualitative component

The key focus of the qualitative component is the relevance, effectiveness, and sustainability of the Mwangaza Mashinani pilot project.[20] For further details on the focus of the qualitative study, including the specific KEQs answered by this component, see Volume II, Annex F.

- As part of the assessment of **relevance**, we assess the extent to which the objectives of the Mwangaza Mashinani pilot project respond to the needs of the target population and the communities it is serving. Crucially, we focus on the population of interest, which is the most vulnerable segment. A key assumption of the qualitative component is that the needs of this particular population are greater than those of the 'poor', and that members of households and communities not only have varying needs but also varying power in accessing and using energy.[21]
- The **effectiveness** assessment focuses on the way the pilot project operations are functioning to identify ways in which implementation can be improved. In addition, this assessment considers whether the project is improving access to and use of energy among the most vulnerable population, and how women in different households, as well as their communities, are benefiting (or not) from the project. In this regard, we explore whether and how the solar devices are being used, by whom, and in what ways. We also try to understand how and to what extent the target population has improved their understanding of, and their ownership of, the solar devices.
- The **sustainability** assessment focuses on identifying factors that enable or hinder the likelihood that the target population will maintain their solar devices beyond the project cycle. Given that the pilot project seeks to reach the most vulnerable households, the qualitative research collected information early in the life of the project on the affordability of the solar devices and their maintenance, and the extent to which the sampled households make an informed choice about whether to use solar devices, and to maintain them in the long run, taking into account other available sources of energy.

[19] See Section 4.3 of Volume I of the evaluation baseline report and Annex C in Volume II of the baseline report.
[20] The focus of the qualitative research was relevance and effectiveness. The qualitative design included preliminary indications on sustainability. However, data on this were limited as communities had only received the first cash top-up at the time of the research and still had to make several more repayments before fully owning their devices. Data collected in relation to sustainability have provided an early indication of the challenges related to sustaining the use of the devices and have been included in this report.
[21] The qualitative study also considers aspects of the project and its assumptions that are not relevant to the target population, if any.

Qualitative sampling and tools

The qualitative research was conducted in January 2020 (eight months into implementation and prior to the onset of the COVID-19 pandemic). In total, we visited four villages: two in Garissa and two in Kilifi. The main qualitative tools used to collect data were semi-structured key informant interviews and community mapping with village leaders, CCs, and members of the BWCs, as well as in-depth interviews with households who are enrolled in the Mwangaza Mashinani pilot project.

- Key informant interviews were conducted with the village leader and a member of the BWC and/or CC in each village.
- Community mapping was conducted with the village leader and CC/BWC member to identify the physical, social, and economic landscape of the community. These maps provided a useful way to understand vulnerability, energy access, sources of conflict, or underlying challenges in the community.
- In each village, three households were selected and in-depth interviews were conducted separately with a man and a woman from the same household.

Further details about the qualitative approach can be found in Volume II, Annex F.

4.4 Implementation review

As part of the implementation review, we conduced qualitative interviews with stakeholders at the national level. The purpose of this data collection was to generate evidence to address evaluation questions related to the relevance, effectiveness, efficiency, and sustainability of the project.[22] The interviews took place after six months of implementation and were timed such that the findings could be taken into account during the design of the second phase of the pilot. The findings and recommendations from the research were presented in a policy note and discussed during national- and county-level workshops held in Nairobi and Kilifi in February 2020.

Stakeholders for the implementation review were selected in consultation with UNICEF and covered funding agencies, development partners, the implementing consortium, and stakeholders from the energy sector and the social protection sector. Data collection took the form of semi-structured, qualitative individual or group interviews with project stakeholders, with most of the 15 interviews conducted face-to-face in Nairobi in November 2019. The same topics were discussed with different stakeholders to allow for triangulation and different perspectives to inform the evidence base. However, not all topics were part of the interviews with each stakeholder and interview topics varied depending on the stakeholder's potential knowledge of the topic. Because of the large number of evaluation questions and topics we sought to cover, the interviews could not explore each topic in-depth.

Further details can be found in Volume II, Annex G.

4.5 VfM analysis

The objectives of the VfM analysis are to review how much the Mwangaza Mashinani pilot project, as managed by UNICEF and implemented by a consortium led by E4I, has spent, and to assess whether the project has provided VfM, being '*the optimal use of resources to achieve intended outcomes*' (UK Department for International Development (DFID), 2011). Based on discussions with UNICEF, for the purpose of this analysis, we focused on three areas of VfM: economy, efficiency, and cost-effectiveness. By looking at these areas, we have attempted to answer the following research questions:

[22] The evaluation matrix in Volume II, Annex B, indicates the different stakeholder interviews our answers to each of the evaluation questions draw on.

- **Economy**: Is the pilot project buying inputs of the appropriate quality at the right price? Inputs include staff, contractual services from external providers, and other goods and services that are used to produce outputs.
- **Efficiency**: How well does the pilot project convert inputs into outputs? Outputs are results delivered by the project, as measured by the project logframe. In this case, the cost efficiency analysis looks at the cost of delivering cash top-ups to beneficiaries, and the cost incurred by the project per beneficiary household.
- **Cost-effectiveness**: How large were the impacts relative to the size of inputs and investment? The cost-effectiveness assessment examines whether the project achieved its intended outcomes on the beneficiaries' sense of ownership, usage, health, and quality of life of children and their families.

Using the UK Foreign, Commonwealth and Development Office guidelines on VfM (DFID, 2011) and OPM's VfM approach (King and OPM, 2018), an assessment framework has been applied that sets out a transparent basis for making evidence-based judgements on VfM. Clarity is achieved by using explicit criteria (aspects of performance) and standards (levels of performance) for each of the VfM dimensions. The criteria and standards are specific to the Mwangaza Mashinani pilot project and are aligned with the project's design and ToC. The VfM assessment is based on a comparison between the identified standards and project-level indicators for each criterion.

The core evidence base for this VfM assessment includes data that are routinely collected as part of the pilot project's monitoring system, UNICEF annual reports to Sida, E4I quarterly reports to UNICEF, the project implementation plan, contracts and memoranda of understanding with key input providers, and budget and expenditure data as recorded by UNICEF and E4I. The analysis also draws on a validation interview with UNICEF and E4I. This includes a mix of quantitative indicator-based measurement and qualitative contextual evidence.[23]

Volume II, Annex H provides further technical detail, including the VfM assessment framework.

4.6 Risks and limitations

This section discusses the specific limitations of each research study.

An overall limitation of **the quantitative component** of the evaluation across the three rounds of data collection is the fact that the midline stage of the evaluation was undertaken remotely, through a mobile phone survey. Although the midline survey was implemented robustly using computer-assisted telephone interviewing software and a data monitoring system that ensured the quality of the data (see Volume II, Annex C for more details), the number and type of questions through which data could be collected had to be curtailed due to the more stringent time requirements of the remote survey mode. As a consequence, the quantitative midline analysis was limited to a restricted number of indicators, and, specifically, only covered a sub-set of health and livelihood impact indicators. Hence, the analyses of trends and over-time impacts presented in this report are limited to the baseline and the endline for the majority of indicators for which no data were collected at midline. Trends including the midline data point are included when possible.

Another overarching limitation of the quantitative component is that the quasi-experimental impact estimates are characterised by limited external validity, since the treatment effect is defined only in respect to households eligible for (ITT estimates) or actually enrolled in (ATT estimates) the pilot project, which may be systematically different on average to households that were not targeted by the Mwangaza Mashinani pilot project. The matching approach based on propensity scores only measures impact for the treatment households that were successfully matched to the corresponding

[23] In this report, costs are reported in US$ and KSH. For reference, at the time of writing, the exchange rate applied is KSH 1 = US$ 0.0088.

comparison households, and its results are thus not generalisable to all vulnerable households in Kilifi and Garissa.

The quantitative endline data collection took place at slightly different times in Kilifi and Garissa. This was due to a pause in data collection between Kilifi and Garissa caused by a political issue concerning the relationship between the local government in Garissa and a number of stakeholders involved in the pilot project. Specifically, the endline survey in Kilifi was implemented from 20 April to 3 May 2021, while the survey was implemented in Garissa from 30 May to 14 June 2021. At the time of the endline survey in Kilifi, the country was entering another lockdown due to the COVID-19 pandemic and schools were closed (also because of the mid-term break). In contrast, most schools opened again by the time the survey was undertaken in Garissa. In order to mitigate this potential issue regarding comparability between the two counties we defined a common reference period (i.e. January to March 2021), particularly for the key indicators on education and child time use.

The qualitative component was originally designed as part of the original endline evaluation activities. Therefore, the research questions and framework were developed to respond to the endline evaluation questions, which aimed to provide a summative assessment of the Mwangaza Mashinani project. Owing to changes in the design as a result of COVID-19 (see Section 3.4), OPM had to make changes to the design and presentation of the evaluation, and the qualitative research took place as part of the new midline stage. However, in line with the scope of the new endline stage, the analysis and findings presented in this report were adapted to contribute to the final assessment of the pilot project.

The implementation review was designed to take place at both the national level and the county level. The county-level interviews were planned to take place at the same time as the originally planned endline survey, in June 2020. However, due to the COVID-19 pandemic, it was not possible during the evaluation duration to conduct these interviews as they required travel to the counties.

The reference point for **the VfM assessment** of a pilot programme is never obvious as the cost of a pilot programme is unlikely to be representative of the scaled up programme, by design. This is because a pilot programme is often innovative, requiring iteration in its design and implementation model, and because it often has disproportionately costly impact evaluation costs, where there is an objective to generate robust evidence against a proof-of-concept objective. In our analysis, we have (wherever relevant) distinguished between the VfM performance of the pilot (where the 'value' relates principally to broader influencing objectives, operational experience, and the evaluation evidence generated) and the likely VfM performance of a scaled-up version of the programme, assuming the core elements of the programme remain the same. A related limitation is that there are seldom other programmes against which the costs of a pilot programme can be compared. For this reason, the benchmarks for this analysis are set using project documents (i.e. proposals, budgets, and contracts), rather than data from other programmes.

The VfM assessment was also complicated due to some inconsistencies in the data, which limited our ability to assess comprehensively all areas of VfM. There are some discrepancies on the spending and results as reported by different data sources, which were not fully clarified. Budget data and actual spending were not reported based on a standardised coding approach: the budget is disaggregated by activity, while spending is coded according to the cost centre money was spent on (e.g. personnel, travel, contractual services, etc.). This makes comparability of budget and spending data difficult, and this has required the team to make a set of assumptions in order to analyse the efficiency of the project. The evaluation team was also not able to access some data disaggregated at the appropriate level for the spending incurred by the consortium led by E4I, which limited the extent to which certain aspects of the VfM assessment could be explored and expanded upon.

4.7 Stakeholder participation

A large range of the Mwangaza Mashinani stakeholders were engaged at each stage of the evaluation cycle. At inception, UNICEF and the E4I-led consortium participated in the development of the pilot project ToC, as well as in the definition of the baseline survey questionnaire and related analysis indicators. As already discussed in Section 4.4, a whole component of the evaluation that was implemented between baseline and midline focused on gathering stakeholders' views on the pilot project's objectives, practical implementation issues and successes, as well as the prospects for future scale-up. In-depth consultations between the evaluation team and UNICEF then took place at the onset of the COVID-19 pandemic, with the aim of agreeing on a re-design of the evaluation set-up and a timeframe for responding to the new challenging context. This led to the successful adjustment of the evaluation, including the shift to remote data collection in 2020 (the new midline) and the inclusion of an additional round of in-person data collection (the new endline) in 2021. At both baseline and midline, results were presented and disseminated to different stakeholders at national and county level through tailored evaluation outputs, including reports, workshops, and technical notes, both in person and remotely, depending on feasibility and budgetary considerations. The endline results will similarly be disseminated through a number of audience-specific evaluation outputs.

4.8 Ethical principles

This evaluation has been conducted in accordance with the United Nations Evaluation Group's Ethical Guidelines for Evaluation and its 2016 Norms and Standards.

Ethical review process

Conducting quantitative and qualitative fieldwork generally, and particularly for vulnerable populations in Kenya, requires high ethical standards to ensure that expectations are not unduly raised, confidentiality is maintained, respondents are never forced to participate or encouraged to speak about subjects that may be traumatising, and that all activities are appropriate (including with regard to age, disability, gender, and diversity, among other dimensions). Ethical considerations influenced the entire evaluation process, including evaluation design, composition, recruitment and management of the evaluation team, consultations and interviews with informants, and data storage and use.

This evaluation was submitted to OPM's Ethical Review Committee for review and approval prior to commencement of field activities. The research team received approval as follows:

- Quantitative impact evaluation component – 15 January 2019.
- Qualitative data collection – 30 December 2019.
- Re-design of quantitative impact evaluation due to COVID-19 – 14 July 2020.

Approval letters and consent forms can be found in Annex K of Volume II.

Ethical considerations during data collection

Regarding the implementation of the household survey, the following principles were applied:

- **Seeking the informed consent of all participants in data collection.** In practice, this entailed providing potential survey respondents with information about the content of the study and how their information would be used, as well as seeking to make them feel comfortable and empowered to refuse to participate or to not answer any questions if they did not want to. The importance of seeking informed consent was emphasised during enumerator training.
- **Maintaining confidentiality and anonymity**: This meant ensuring that participants would not have their personal information shared, or be at risk of being individually identified from their participation in the survey. During fieldwork, every effort was made to ensure that interviews were

always conducted in a quiet and private location. During data analysis and the writing up of the results, households' identifying information was not shared with anyone beyond the small analysis team, and we ensured that individuals could not be identified in reports written using the data collected from the survey. Ensuring privacy during interviews was particularly challenging during the mobile phone survey as the interviewers were not able to ensure that the respondents were alone during the interview. We ensured that part of the consent procedure ascertained whether the respondent was comfortable to proceed with the interview at that time and, if not, another time was arranged to afford the respondent privacy.

- **Ensuring the safety of the research participants** and respecting cultural sensitivities throughout all interactions with participants. All OPM employees have completed mandatory safeguarding training and have signed the Safeguarding Policy, Principles for Practice. As part of fieldwork training, all fieldworkers and enumerators received safeguarding training, including on the processes to follow should a safeguarding issue arise.
- **Provision of information on COVID-19**. At the end of each interview, we provided respondents with information related to COVID-19 and details on toll-free numbers in Kenya that have been set up for this purpose.
- **Protecting the safety of the local researchers** who conducted data collection, and respondents. To protect local researchers and respondents during this assignment, the midline household survey data collection took place remotely to ensure that the research did not result in the spread of COVID-19. The endline household data collection was conducted in line with detailed COVID-19 protocols that were put together by OPM to ensure the safety of our researchers and respondents. This included wearing masks, maintaining social distancing, testing researchers prior to fieldwork, and administering a COVID-19 screening module to all respondents.

5 EVALUATION FINDINGS

5.1 Relevance

Box 2: Summary of findings related to relevance

The pilot project's objectives seem to be relevant for both the targeted beneficiary households (given their lack of access to modern energy sources) and the solar energy suppliers that are interested in exploring new remote markets. The project is also relevant to, and aligned with, the GoK's agenda.

- **Energy access**: The majority of households enrolled in the pilot project did not previously have access to modern energy sources for lighting and charging mobile phones. Among the households without a solar device at endline, affordability remains a key constraint on accessing solar energy.
- **Energy market**: Both solar suppliers are interested in continuing to be involved in the pilot project. Both noted that the guarantee is an important feature of the project, which incentivises and de-risks their expansion into underserved areas and markets.
- **Policy context**: The pilot project is aligned with the GoK's social protection and energy objectives, although the level of lighting provided is low.

5.1.1 Relevance to the needs and priorities of the target population and their communities

The findings from the baseline survey indicated that almost all households enrolled in the Mwangaza Mashinani pilot project have limited access to modern energy sources for lighting and charging mobile phones, with only a small minority owning a solar device or solar lantern (3% of households for both) prior to implementation. The baseline survey also found that half of respondents would be interested in buying a solar device. However, among those who did not want to purchase a solar device, affordability was seen as a key constraint.[24] By endline, among the minority of households that do not have a solar device, the majority reported that they would be interested in buying a solar device for lighting but have not done so due to affordability concerns.

Qualitative research at midline confirmed that financial constraints are the key reason households choose not to buy solar devices. This is especially evident in a community sampled by the qualitative study in Garissa that had previously been selected to participate in the Millennium Village Project (MVP).[25] Several households enrolled in the Mwangaza Mashinani pilot project had previously received a solar device as part of the MVP. Their original solar devices had since stopped working, and, despite the benefits that they had offered, households had not bought another device because they could not afford to.

> *'There is a very big problem about power. All government activities work under solar. Several schools are operated with solar and people progress economically through solar. When [you] need power, you purchase your own generator or equip yourself with a solar device. The common person has no power and he/she stays in a blackout. Wake up in a blackout and sleep in the blackout.'*
>
> Chief, Garissa

Across the board, national stakeholders interviewed as part of the implementation review felt that the pilot project was relevant for households. Specifically, they noted that 78% of households that enrolled

[24] A full discussion of relevance can be found in the baseline evaluation report.
[25] The MVP was a 10-year, multisector, rural development project, operating in 10 sites in 10 African countries. The project implemented integrated interventions, with solar devices distributed as part of the infrastructure strengthening initiative. For further details, see here.

in the project actually purchased the solar device, which was deemed a success given that households had to pay a commitment fee to enrol in the project and were initially expected to fund part (~10%) of the two-monthly repayment themselves. Further, the solar suppliers reported that a few households had selected more powerful (and more expensive) solar devices than those offered through the project.

As discussed in Section 5.4.1.2, the penetration of solar devices in the surveyed communities has increased between baseline and endline. A quarter of beneficiary households reported owning another solar device besides the one supplied by the project. Further, of the households that were intended to enrol in the project but did not, 38% reported owning a solar device. Similarly, while only 4% of households in the control sub-counties owned a solar device at baseline, 27% of households own a solar device at endline (see Table 4). Interviews with national stakeholders indicated that households living in treatment communities, or nearby, were able to purchase the devices on similar pay-as-you-go repayment terms as those offered under the project.

5.1.2 Relevance for suppliers

The Mwangaza Mashinani pilot project initially signed memoranda of understanding with three solar suppliers. However, shortly after the project began, Green Light Planet pulled out of the project, citing challenges in reaching remote areas and the inability to modify its business model to fit the project's design. In addition, stakeholders interviewed as part of the implementation review speculated that its withdrawal was either due to low demand for solar lanterns, in comparison to solar devices, or the relatively small size of the project in relation to Green Light Planet's regular sales volumes.

From the perspective of the remaining solar suppliers, the pilot project is seen to be relevant and interesting as both d.light and Bright Sky Solar Solution have a social impact motive alongside operating as for-profit companies.[26] Both suppliers mentioned the guarantee mechanism as an important part of the project, which de-risks the expansion of their businesses and increases their willingness to venture into new markets.[27] As part of the implementation review, both suppliers noted that they would be interested in expanding the project within Kilifi and Garissa or to new counties, caveating that they would need a similar de-risking arrangement to be in place for expansion into similar markets to be feasible.

5.1.3 Alignment with government policies

The pilot project is aligned with the social protection sector's priorities to support households to live a life of dignity and to enhance the capacity and opportunities for the poor and vulnerable to improve and sustain their livelihoods and welfare. The GoK has implemented a number of 'cash plus' projects in pursuit of these objectives. Stakeholders in the DSA[28] and SPS noted that spending on energy was a priority for them given that the provision of access to clean energy helps to achieve their objective of reducing poverty and enabling households to live a decent life. Promoting linkages between the social and non-social sectors was also part of Sida's strategy.

In addition, the project is aligned with the MoE's priority of achieving universal electrification by 2022, which requires the provision of energy solutions to the poorest households. The MoE's approach, including under KOSAP, is to facilitate the entry of the private sector into underserved regions by de-risking their expansion. However, the Mwangaza Mashinani pilot project's approach is complementary to the efforts of KOSAP, which does not have a subsidy focus and hence does not address the affordability constraint on the demand side. If the MoE is to reach the most vulnerable segment of the population, who are most financially constrained, a focus on affordability will be crucial.

[26] Due to budgetary constraints, only d.light was engaged in the second phase of the programme.
[27] The guarantee mechanism was used to pay for the devices of 92 households.
[28] Formerly the Social Assistance Unit.

It is worth nothing that, while aligned with the MoE's priorities for lighting, the Mwangaza Mashinani pilot project only provides a low level of energy access for lighting, and does not address the issue of clean cooking solutions for households. The implementing consortium and stakeholders in the energy sector acknowledged that the project offers a starting point in terms of trying to reach the most vulnerable households with clean energy solutions.

5.2 Effectiveness

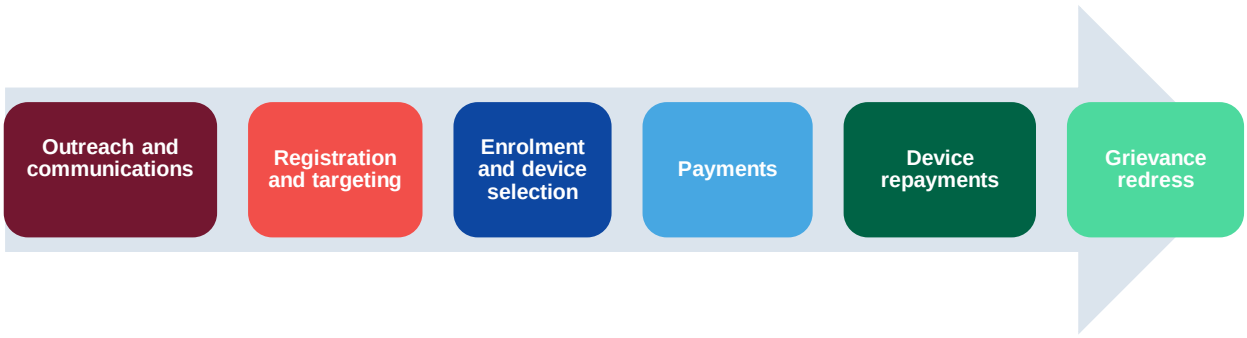
Box 3: Summary of findings related to effectiveness of project operations

Overall, the pilot project was able to successfully register, target, and enrol over 2,000 vulnerable households in its first phase. The project was also able to distribute solar devices and deliver six cash top-ups to beneficiaries (with the final payment successfully disbursed during the COVID-19 pandemic). However, along the delivery chain, a number of challenges have been faced, many of which are due to weaknesses in project outreach and communications due to limited implementation of the BCC component. In addition, the project relies heavily on the Inua Jamii's delivery systems, especially for targeting and payments, and therefore weaknesses in the Inua Jamii's service delivery are inherited by the project.

- **Outreach and communications**: Weaknesses in outreach and communications have undermined other aspects of the pilot project's service delivery.
- **Targeting and registration**: Targeting was successful, with most households meeting the eligibility criteria. However, there was also the perception from some village leaders that not all vulnerable households had been included.
- **Enrolment**: The project was able to meet and exceed its enrolment target in the first phase of implementation, although 33% of households in our evaluation sample that were intended to be treated did not enrol. The process of enrolment differed by community, which undermined the intended registration and targeting process.
- **Commitment fee**: Almost half the households that enrolled in the pilot project paid the commitment fee using money provided by project staff or family/friends.
- **Device selection**: While households were aware that two devices were offered through the project, it is not clear that households made an informed selection. 79% of households that enrolled in the project ultimately selected and received a device.
- **Cash top-up payments**: Challenges faced by Inua Jamii beneficiaries in accessing their regular payments were inherited by the project. Payment delays are problematic as this undermines households' ability to make timely repayments to solar suppliers.
- **Repayment process**: Households struggled with the repayment process due to a lack of financial literacy or challenges in using M-Pesa, in many cases requiring support from the chiefs and CCs to facilitate repayments.
- **Grievance mechanisms**: The majority of households are not relying on the appropriate contact person to resolve problems related to the devices or cash top-ups.

In this chapter we provide a summary of the findings related to the effectiveness of the implementation of the pilot project. These findings were first presented in the midline evaluation report, where a full discussion can be found, and are organised according to the pilot project's delivery chain (Figure 5).

Figure 5: Mwangaza Mashinani pilot project service delivery system



5.2.1 Outreach and communications

Sensitisation

Outreach and communications for the Mwangaza Mashinani pilot project take place through multiple channels, including solar companies, government departmental representatives, media campaigns, chiefs, BWC members, and CCs. The implementing consortium also uses interactive voice response calls and text messages and distributes brochures and FAQs.

Qualitative findings at midline indicated that the effectiveness of outreach varied. For example, not all members of the community were informed in time about the *barazas* or their purpose, and in some cases meetings took place too quickly, without adequately assessing participants' understanding of the topics discussed. In some villages, households that received information during a BWC member's home visit felt they had a better opportunity to ask questions and receive information. In other cases, it was felt that the awareness-raising campaign was most successfully implemented in conjunction with in-person meetings with the community when these were also convened with village leaders, BWC members, and CCs. Both villages in Garissa felt that the effectiveness of the awareness-raising campaign was limited by the restricted signal for radio or television transmission.

Ongoing communications

The pilot project was designed to include ongoing communication with the project's stakeholders, including messages to be cascaded to beneficiary households related to project delivery (e.g. registration and enrolment processes, payments (and delays), repayment mechanisms, etc.).

Our findings show that appropriate communication systems were not adequately set up at the start of the project, leading to challenges across the delivery chain. In relation to targeting and enrolment, chiefs reported that they received limited information about the project enrolment process, and this lack of clarity around eligibility and enrolment filtered down to the CCs, BWCs, and households themselves.

Similar inefficiencies in communication also affected the payment and repayment processes. For example, in Kilifi, some households received the cash top-up prior to receiving the device, and used the money for other purposes, and so did not pick up their device. Responses from the BWCs, CCs, and chiefs suggest that they do not fully comprehend the repayment system, including details on the commitment fee and managing subsequent payments. This is compounded when the Inua Jamii payments are delayed (see Section 5.2.4).

The implementing consortium also uses technology-based approaches (interactive voice response calls and text messages) to communicate with households about repayment. However, concerns about this communications approach include whether interactive voice response calls or text messages reach the relevant household member, and how to communicate technical issues to people with low levels of technology literacy.

Finally, it is also worth noting that while the pilot project was conceptualised as having an explicit gender focus, it was clear during the implementation review and the qualitative research that gender

was not considered in the design of the communications strategy. Findings from the implementation review suggest that the difference in access or needs for women and men was not considered when designing the communication. Qualitative research finds that the household head is invited to the *barazas*, and usually the oldest male member attends the meeting.

5.2.2 Registration and targeting

Registration

The qualitative research found that the pilot project did not follow a systematic process for registration. Households were registered in different ways, depending on their location. In Kilifi, some households were not aware of the project or the registration process, but were asked by village elders to go to the chief's house to register their names. Solar devices were then distributed according to this register. In Garissa, and from the perspective of the BWCs, not all households who registered on the first day of the project received a solar device, though some received the solar cash transfers nonetheless.

BWCs and CCs reported a lack of training provided to them by the pilot project. To improve registration, BWCs and CCs suggested the project present clear information on what the registration process ought to be, and outline different channels for communication and obtaining information about the project.

Targeting

Overall, the pilot project has been effective in targeting communities and households that would otherwise not have been able to afford the solar devices. Findings from the baseline survey indicated that households in the evaluation sample targeted by the project[29] (although not necessarily enrolled) largely met the project's eligibility criteria.[30]

The pilot project also seeks to target the most vulnerable households in Kilifi and Garissa. This is achieved by piggybacking on the Inua Jamii's poverty-based targeting approach and only selecting households enrolled in the Inua Jamii for the Mwangaza Mashinani pilot project. While we did not assess quantitatively whether beneficiary households are indeed the *most* vulnerable, our qualitative research suggests that the project is appropriately targeted:

> *'To speak the truth, the programme has really helped because most of them had no lights, they slept like that. They used tin lamp, and the smoke enters the nose, they were suffering. But when the programme came, people now are happy. Children now study well as she has said. It is like a gift from the organisation without them giving money.'*
>
> BWC member, Kilifi

Despite this, there was also a feeling that the eligibility criteria exclude some vulnerable households from being part of the project in Garissa and Kilifi. Village leaders suggest that, going forward, the project could also target vulnerable households outside of the Inua Jamii. Stakeholders interviewed as part of the implementation review echoed this sentiment, recognising that the Inua Jamii does miss some vulnerable households, due to exclusion errors and categorical targeting.

[29] Some households that were enrolled in the pilot project were not listed as part of the verification exercise, and therefore were not included in the baseline survey's sample frame. For this reason, we cannot assess the extent to which these households meet the project's eligibility criteria.

[30] The final project eligibility criteria differed from those presented in the project's operations manual as some criteria were altered after the verification exercise indicated that fewer households were eligible for the project than had been anticipated.

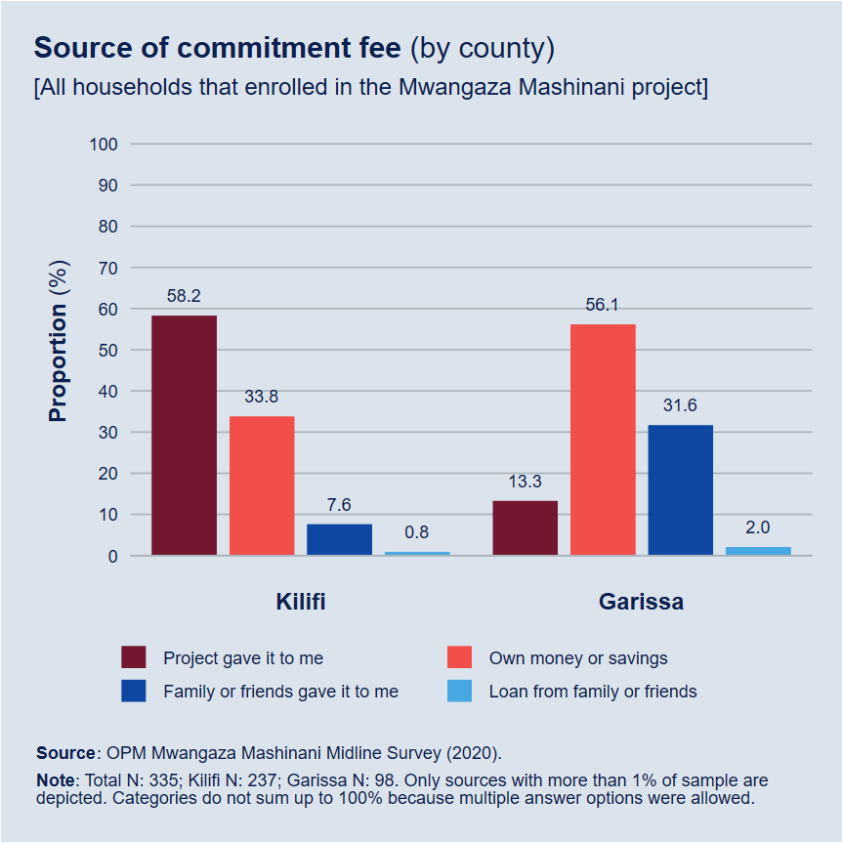
5.2.3 Enrolment and selection of a device

Enrolment

The project successfully enrolled 2,134 beneficiaries in its first phase of implementation, of which 63% were female. While the pilot project design documents emphasise the importance of targeting women as part of the project, during the implementation review it was clear that there is no explicit gender focus in terms of targeting female beneficiaries (either as the household head or households with female children).

The qualitative findings suggest the process of enrolment deviates from the implementation plan and differs both between and within counties. Deviations are often to the detriment of the project's design and undermine the sense of ownership of the solar devices that the project seeks to achieve. For example, the qualitative research found that some solar devices were provided without requiring beneficiaries to pay the commitment fee or in other cases, that the commitment fee was paid by someone other than the beneficiary. The midline survey confirmed that this problem was widespread (Figure 6): in Kilifi, the majority of households (58%) relied on project money to pay for the commitment fee, while only 13% of households in Garissa reported this having happened. Indeed, more households in Garissa cited using their own money or savings and family networks as sources for the payment of the commitment fee.

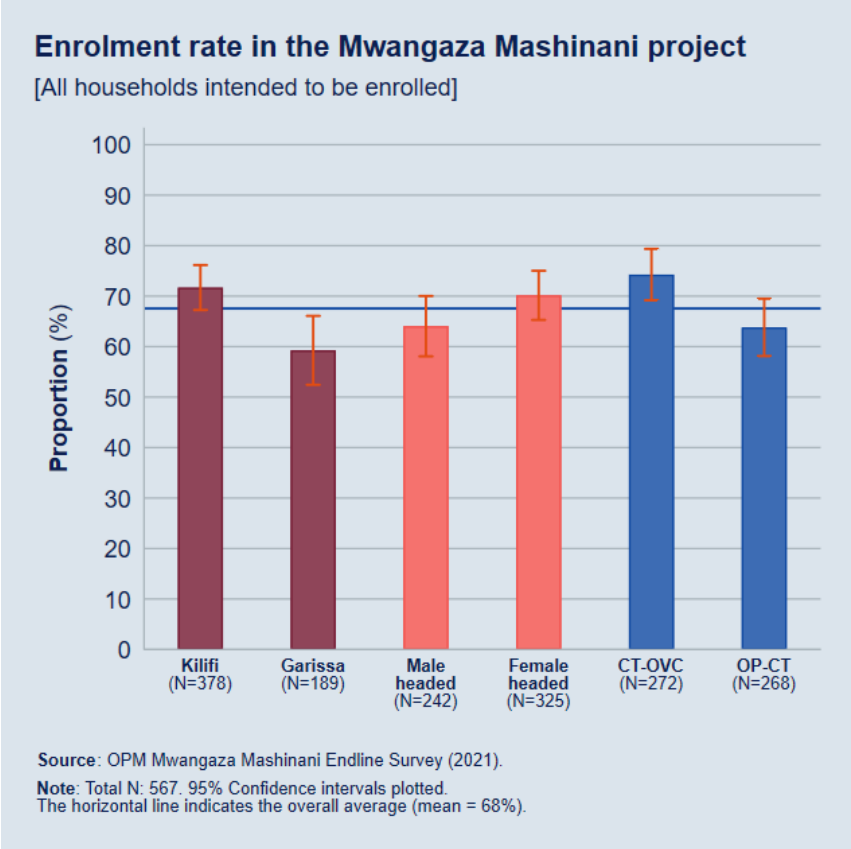
Figure 6: Source of funds to pay commitment fee (by county)



The *ad hoc* enrolment processes followed in each community resulted in households not originally listed during the verification exercise enrolling in the pilot project, as well as, conversely, households identified during this exercise not enrolling in the project. The endline survey shows that only 68% of the households that were intended to be enrolled in the pilot project at baseline (that is, the sample of households that formed our treatment group at baseline) actually ended up enrolling in the pilot project and receiving the solar device (Figure 7). The enrolment was more successful in Kilifi, although still below the initial target: 72% of targeted households actually enrolled, compared to only 59% of

targeted households in Garissa. We also find significant differences in the enrolment rate by type of cash transfer the household receives, whereby more CT-OVC recipients (74%) enrolled than OP-CT recipients (64%). While we find that more female-headed households (70%) enrolled in the project than male-headed households (64%), this difference is not statistically significant.[31]

Figure 7: Households intended to be treated that enrolled in the pilot



Selection of the devices

The endline survey results show that 51% of beneficiaries selected the d.light device while 49% selected the BioLite device. Significantly more households in Garissa selected the BioLite device (by 11 percentage points).

In general, households were aware that two solar devices were offered through the pilot project and that they had a choice of which device to purchase. The qualitative findings suggest that respondents' familiarity with using non-project solar devices, and awareness of the different cost of the devices,[32] were contributing factors in the selection of the device. Some households in Garissa perceived that most beneficiaries chose the d.light solar device due to familiarity with the product (e.g. from purchasing d.light devices independently), or from receiving the d.light device through other programmes, such as the MVP.

Knowledge about the difference between these two devices is variable, which can partially be explained by differences in processes for informing communities about the devices, and the extent of household-level engagement by the BWCs, CCs, and solar providers. The level of literacy and numeracy of beneficiaries appears to impact households' capacity to make an informed choice

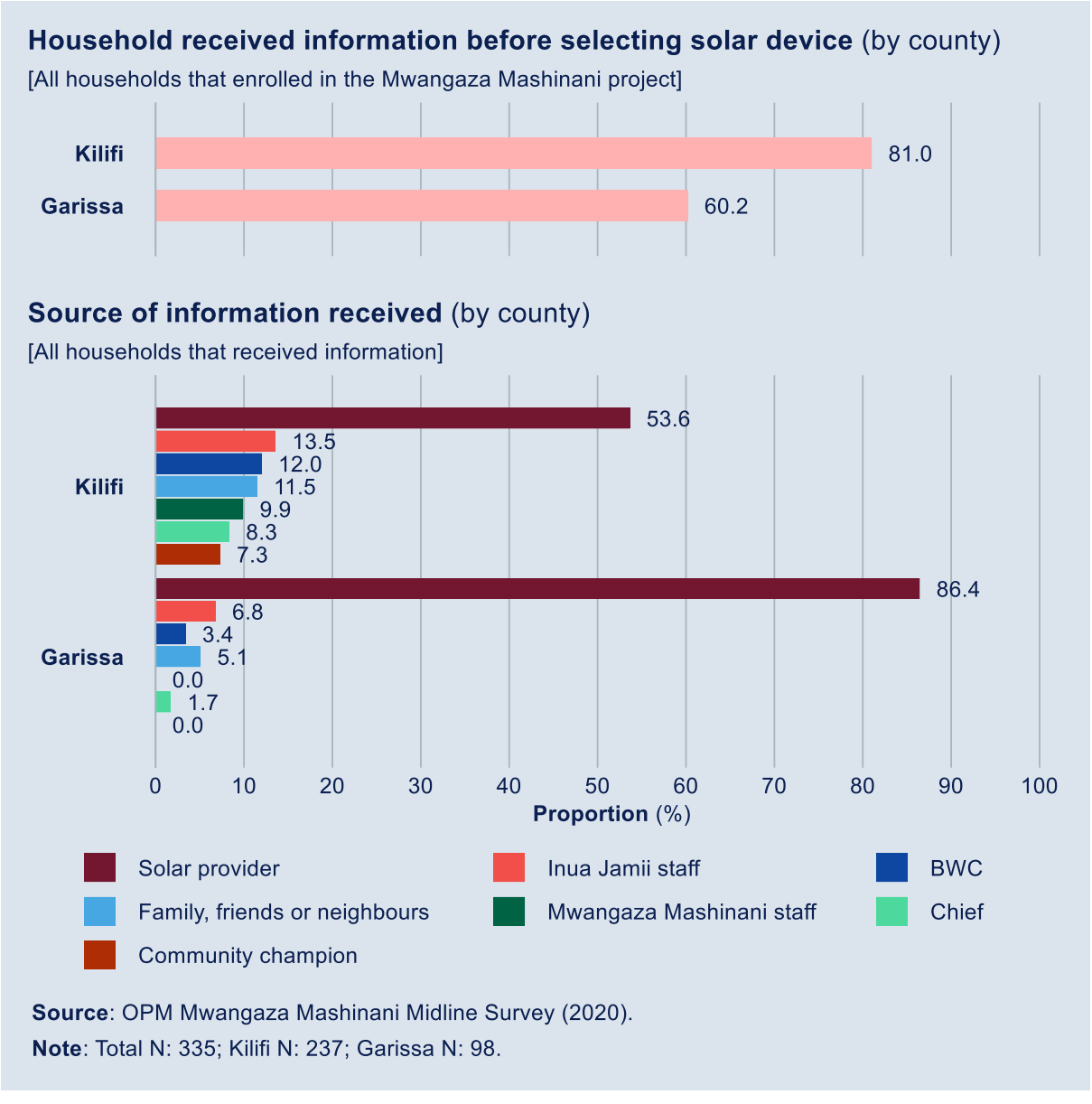
[31] It is important to note that household head gender is correlated with cash transfer type, and both are correlated with county. To isolate their correlations with enrolment in the project, we conducted a simple regression analysis. We find that only cash transfer type is independently correlated with the probability of enrolment in the project (see Volume II, Annex D).

[32] The first repayment for the BioLite device was KSH 2,850, compared to a first payment of KSH 3,150 for the d.light device. However, repayments were later adjusted to align the repayment amounts for both devices.

between the two devices. This may have been an issue for many households, given the low levels of literacy found in the baseline survey: 83% of heads in beneficiary households have never attended school. In some communities, solar suppliers brought sample devices to demonstrate the benefits of each device and to inform beneficiaries' choice. In other communities, households were provided with a leaflet and asked to select their device. Some households chose the particular device simply because they were being asked to make a choice between different images on a card. It is therefore unclear whether a real 'choice' was made between the two devices. The following excerpt relays a male household member's account of how his mother (the beneficiary) chose the BioLite device:

> *'Actually on that I don't know, because when she came to explain it to me, she said they were shown about it from a picture and my mum is illiterate. From the first explanation they got they were given and shown from a picture to choose from with her other counterparts. So, she pointed out and chose from the number of pictures that were shown there, so when she pointed it, it was the BioLite solar.'*
>
> Male household member, Kilifi

Figure 8: Information received by beneficiaries prior to device selection (by county)



Source: OPM Mwangaza Mashinani Midline Survey (2020).

Note: Total N: 335; Kilifi N: 237; Garissa N: 98.

The midline survey corroborated these findings, showing that provision of information about the solar devices before selection varied across counties. A sizeable minority did not receive any information at

all. Specifically, three-quarters of beneficiaries reported receiving information about the device before they selected it. Figure 8 shows that this proportion was significantly higher in Kilifi than in Garissa (by 21 percentage points). The main source of information about the device prior to selection was from solar providers (cited by 61% of households), followed by Inua Jamii programme staff (12%), BWCs (10%), and family, friends, or neighbours (10%). There are county-level differences as well, with significantly more households in Garissa receiving the information from solar providers while households in Kilifi relied more on the BWCs, Mwangaza Mashinani project staff, and CCs.

Distribution and take-up of the devices

Overall, the project distributed 1,692 devices to households in Kilifi and Garissa. There were some initial issues in terms of distributing the devices at the same time as the first top-up payment, which resulted in some households not taking up the devices as they had used the funds by the time the devices were available. Despite this, take-up during the first round of payments was close to 70% and by the end of the project 79% of households that initially enrolled had received a device.

Installing and operating the devices

The qualitative research found that households in both Kilifi and Garissa were able to install and use the solar devices effectively, with the support of CCs and non-project community members. We find that selection and installation of the devices is usually entrusted to elder sons by older beneficiaries (OP-CT beneficiaries, aged 65+ years) and those who are illiterate. While the device is registered in their name, elderly beneficiaries rely on their children to provide their contact details at registration at sensitisation meetings, to decide whether the device should be acquired, to install and operate the device, and, in some cases, to assist with repayments once Inua Jamii payments and cash top-ups are received. There is hesitation among elderly female beneficiaries, in particular, about operating the device, for fear of damaging the apparatus, and elder children teach them how to switch the device on and off, but nothing more complex than that. This means women do not use the devices to their full potential: for example, for powering a radio or charging their phones.

Qualitative household interviews suggest that some training was provided, with fairly detailed instructions provided in an accompanying manual. However, findings from the endline survey indicate that only 39% of beneficiaries received any information or were given training related to the solar device, with significantly fewer households receiving information or training in Garissa than Kilifi. Specifically, 52% of households in Kilifi reported receiving information or training, compared to only 8% of households in Garissa. There were no differences related to gender of the household head of the cash transfer programme.

Overall, this meant that only the minority of households received information and/or training related to the following topics: general use of the device (44% in Kilifi vs 7% in Garissa), payment modalities (42% vs 6%), installation of the device (37% vs 7%), maintenance of and care for the device (35% vs 5%), use for income-generating activities (28% vs 5%), use for other ways to diversify income (18% vs 4%), and financial management and savings (14% vs 4%).

5.2.4 Cash transfer payments and device repayments

Cash transfer and related challenges

The payment and repayment structure of the Mwangaza Mashinani pilot project is designed to align with the schedule of payments under the Inua Jamii. Cash top-ups are supposed to be disbursed to households on a bi-monthly basis, at the same time and to the same bank account as the regular Inua Jamii cash transfer payments. This alignment is crucial in order to reduce transaction costs for households (e.g. transport costs and withdrawal fees) and to reduce the risk that the top-up is spent on other immediate needs, including consumption, education, and health.

It is worth noting that, during Phase 1 of the pilot project, payments of the cash top-up were made to the banks in parallel by UNICEF, rather than through the government's systems. Stakeholders did not think it would be efficient for the payments to be fully integrated with the government payments at this stage, as this would be time-consuming and burdensome. This does mean, however, that the implementing consortium needs to undertake a reconciliation and update the payroll. It is still to be determined who would take this on when scaling up the project.

The biggest challenge faced by the project has been the unpredictability of the timing of the Inua Jamii payments, and by implication cash top-ups, which has affected the timing of the repayments (see Box 4). Delays to the Inua Jamii resulted in two combined 'double' payments taking place as part of the Mwangaza Mashinani pilot project: cycles 2 and 3, and cycles 5 and 6 were combined. In both Kilifi and Garissa, households appear to be accustomed to – though nonetheless frustrated by – delays to their Inua Jamii payments.

Box 4: Payment delays in November 2019

Inua Jamii payment delays in September 2019 resulted in the second payment cycle of the Mwangaza Mashinani project being skipped. This required the project to simultaneously disburse the second and third top-ups, and for households to make a double repayment at the end of November 2019. In order to fill the gap, suppliers extended additional light to households, though not for the entire duration of the delay, and, ultimately, almost all beneficiaries' devices were switched off for some time (from one week to two months).

Weaknesses in the project's communications channels exacerbated the challenges associated with the payment delays. The project sent a text message to beneficiaries to warn them about the delay and to provide additional tokens to continue to make solar repayments. However, qualitative interviews suggest that not everyone understood how to interpret the message, or the process to be applied, and in some cases beneficiaries deleted the text message and token. In most cases, beneficiaries simply waited for the devices to be switched on again, suggesting a lack of agency and ability to hold suppliers and/or the project to account.

Limited sensitisation of BWCs, CCs, and chiefs meant community leaders were less able to support households during the payment delays. BWC members felt that they did not receive clear communication as to why the lights were switched off, and they were neither trained nor supported to provide warnings or advise beneficiaries on what to do. In some cases, beneficiaries blamed the BWC members for the devices not working.

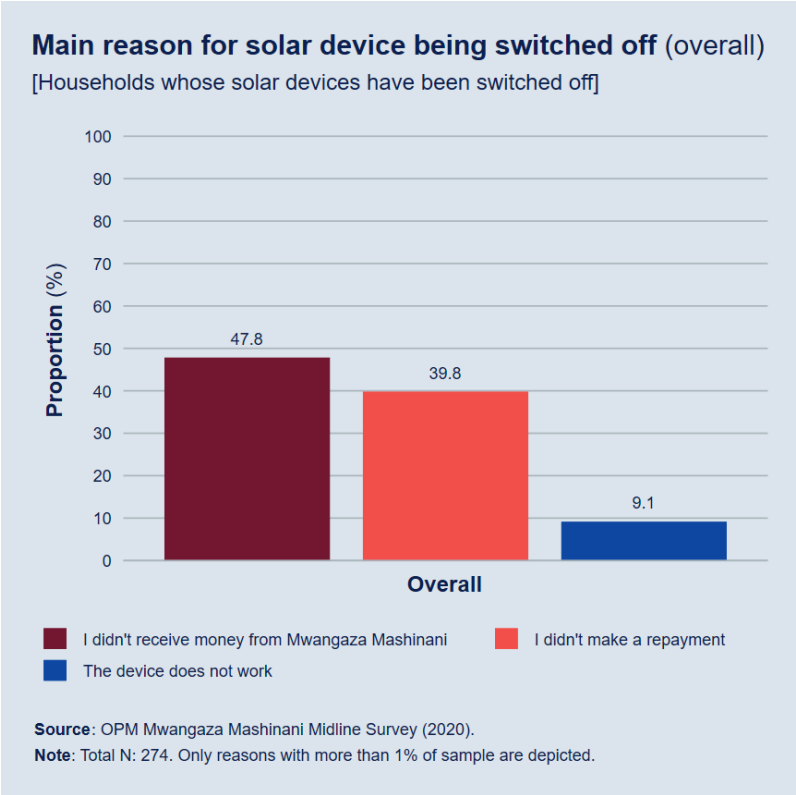
The qualitative findings suggest that delays affect beneficiaries' sense of ownership. In particular, the lack of communication about the payment delays and subsequent switch-off led to confusion and, in some cases, a breakdown in trust between the solar providers, community support structures, and beneficiaries. This incident also serves to highlight the challenges inherited by the project due to piggybacking on the Inua Jamii's delivery systems, which have served to distort the use of, and sense of ownership over, the solar devices.

The implementing consortium does not have a protocol in place for managing these delays, despite stakeholders being aware that delays occur frequently. This means that most beneficiaries are not forewarned about delays and are not able to make repayments for the devices on time, resulting in their devices being switched off. In most cases, households wait for the Inua Jamii transfer to arrive; they rarely report making repayments for the solar device from their own money when there are delays. Community leaders and CCs interviewed as part of the qualitative research highlighted that delays in cash transfers in some cases have knock-on effects on households' likelihood of making subsequent solar device repayments, as they revert to other forms of energy use when the lights are switched off and may not necessarily feel compelled to go back.

The midline survey found that the majority of beneficiaries (82%) have experienced a switch-off since receiving the solar device, with no significant difference across counties. The main reasons provided by households for this switch-off are related to the payment for the device (Figure 9), with 48%

reporting that it was because they did not receive money from the project, and 40% reporting that it was because they did not make the solar device repayment. A small proportion (9%) reported the solar device not functioning as the main reason for being without light.

Figure 9: Main reason for solar device being switched off since receiving it



A second challenge in relation to payments is that the process of collecting payments is difficult for old and vulnerable recipients, and the focus of the Mwangaza Mashinani pilot project on targeting remote locations presents additional challenges. Usually, when the cash transfer arrives in bank accounts, bank agents come to the nearest town to disburse the cash. However, the transaction and personal costs incurred to withdraw the Inua Jamii cash transfer from the bank, even before any solar device repayment is made, can still be high, and elderly and infirm beneficiaries often need assistance with collection. These challenges are exacerbated in one location in Garissa, which does not have bank agents who are willing to travel to their community for small transactions.

Repayment to solar providers

Qualitative interviews suggest variable levels of understanding of the solar device repayment process, which can be attributed to a lack of financial literacy; a lack of knowledge about what they are entitled to as part of the Inua Jamii cash transfer; a misalignment of payments between the Inua Jamii and the Mwangaza Mashinani pilot project; and challenges in using M-Pesa. As a result, several stop-gap arrangements have emerged.

In Kilifi, difficulties were experienced with the mobile top-up process and, as a result, in-person payments are preferred, particularly among some of the elderly beneficiaries. To this end, the solar supplier meets beneficiaries at the chief's office to receive repayments. In both counties, households also make repayments by bringing the money to the BWC or CC, who then makes payments through M-Pesa so that tokens are released to switch on the device.

One of the BWCs in Garissa had the perception that households do not fully understand the repayment process, due to low levels of literacy. It becomes even more difficult to manage repayments when the Inua Jamii and top-ups are received at different times. It was reported that some

beneficiaries do not understand the concept of an account number, and even when they withdraw the money they do not understand the transfer value of the Inua Jamii vis-à-vis the Mwangaza Mashinani pilot project, or know how to make the repayment:

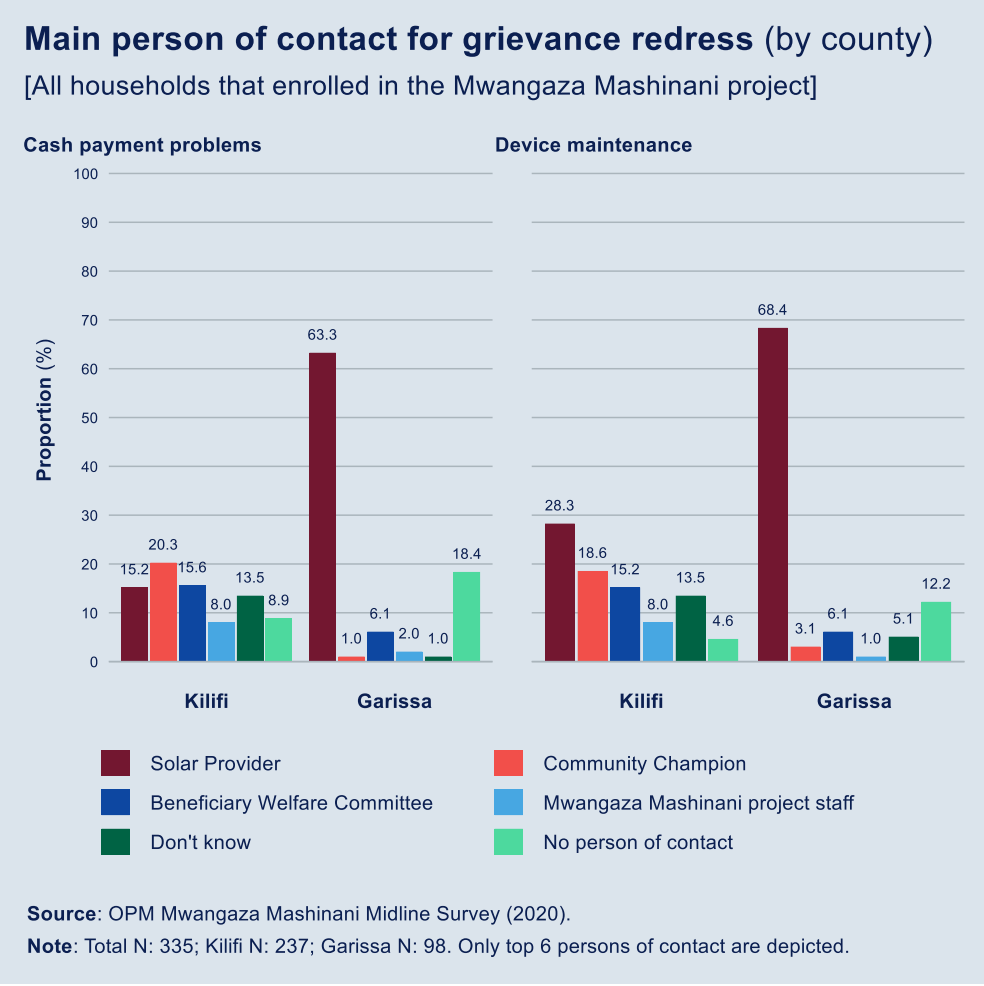
> *'They don't understand the time the tokens get finished, it remains 10 days, seven days, they don't know until solar is switched off. Again, they don't understand the money for the old people and money for the solar, they see all the money belongs to them and they squander all the money saying it belongs to them… they see it as that of the old people. So, it is difficult even if you explain to them, they don't understand.'*
>
> CC, Garissa

That said, a few beneficiaries in Garissa said that they experienced no problems with making the solar device repayment, receiving the token, and entering it into the solar device. However, these individuals either have previous experience with solar devices, or they make regular M-Pesa transactions. In sum, we infer that further training of beneficiaries is needed across the board to enable a more standardised repayment system using the token and M-Pesa system.

5.2.5 Grievance redress

The results of the midline survey show that the majority of households are not relying on the appropriate channel or point of contact (POC) for reporting grievances. The survey did not explore why that is the case; however, the finding that many households do not contact the appropriate POC implies reduced effectiveness of the grievance mechanism, and reduced likelihood of households receiving the support they need.

Figure 10: Main POC for grievance redress (by county)



Source: OPM Mwangaza Mashinani Midline Survey (2020).
Note: Total N: 335; Kilifi N: 237; Garissa N: 98. Only top 6 persons of contact are depicted.

For issues related to receipt of the Mwangaza Mashinani top-up, households are expected to contact the BWC or CC. Evidence from the midline survey implies this does not take place. Only a minority of households reported the BWC (13%) or CC (15%) as being the main POC for issues related to the top-up, while 29% of households reported the solar provider as the main POC, and 20% reported other actors, such as Inua Jamii staff, Mwangaza Mashinani project staff, and the chief. A sizeable proportion (22%) reported that they do not have a POC, or do not know who their main POC is. Households in Kilifi are significantly more likely to contact the BWC (by 10 percentage points) or CC (by 19 percentage points) for cash-related problems, as shown in Figure 10, while the overwhelming majority of households in Garissa (63%) consider the solar provider to be the main POC.

Regarding problems related to the maintenance of the device, the expectation is that beneficiary households will contact the solar providers. However, again, the midline survey found that a minority of households (40%) consider the solar provider as the main POC for maintenance issues. There are also stark differences across counties (Figure 10): about two-thirds of households in Garissa consider the solar providers to be the main POC while less than a third of households in Kilifi do, more commonly reporting the BWC or CC as the POC. As discussed in Section 5.5.2, findings from the endline survey suggest that only a minority of households who had to repair their device went to the solar supplier for the repair.

When households have contacted their reported POC for cash- and device-related issues, the POC has not always been helpful. This may be because households are not contacting the appropriate POC for the issue faced. Among beneficiaries who have a contact to whom they report cash-related problems, 56% said that they reported problems with receiving the top-up to their POC. While the majority of these households (66%) consider the POC to be always helpful, 16% said they were sometimes helpful and 8% said they were never helpful. Similarly, in contacting the POC for problems related to maintenance, among the 39% of households who contacted the POC, slightly more than half (56%) found the POC to be always helpful.

5.3 Efficiency

Box 5: Summary of findings related to efficiency

In terms of coordination, we find that the pilot project is well-coordinated at the county level but that national-level coordination could be strengthened. The VfM analysis indicates that the pilot project meets the definition of 'good' in regard to the standards for economy, 'average' for efficiency, and 'average' and 'good' in relation to cost-effectiveness for education and energy use, respectively. However, the VfM performance of the project at scale is expected to improve for all three dimensions provided current performance levels are maintained.

- **Coordination**: Most national project stakeholders felt they had been informed of the project design and implementation but that they could be more closely involved in the project going forward. The county technical working groups are considered to be well attended and the county governments have generally been supportive of the project.
- **Community structures**: The pilot project has been implemented using local structures that are also part of the Inua Jamii, including chiefs, children's officers, and BWCs. The project has also set up its own structures, including CCs, to embed the project in the communities. However, the majority of households are not aware of the CC in their area.
- **Economy**: The pilot project minimises the transaction costs of the cash transfers, as well as operational and staff costs related to UNICEF's activities. However, contractual services cost more than expected. While the project followed sound procurement practices in selecting the solar suppliers, the final cost of the solar products was above the budgeted amount.
- **Cost efficiency**: Most activities have been implemented within budget, although the pilot project allocated more resources to set up, inception activities, and implementation, compared to the budget. This was due to delays in the procurement practices and challenges emerging from contextual factors, some unforeseeable. Despite the initial delays, by June 2020 most logframe targets had been achieved. Nonetheless, 22% of enrolled households decided not to purchase the solar device and 30% of beneficiaries do not regularly make repayments for the device.
- **Cost-effectiveness:** Excluding pilot-related costs, it is estimated that the cost of the project requires US$ 11.40 to be consumed to increase a child's attendance in school by one day. Further, it costs US$ 2.30 to increase a child's study time by one hour at night. In relation to energy use, Mwangaza Mashinani households are benefiting from an average of 3.4 hours of extra energy use per day. The cost-effectiveness indicator states that it costs US$ 0.13 for one extra hour of energy using solar devices as an extra source of energy, which is lower than the cost of using mini-grids as an alternative source of renewable energy.

In this section we discuss the efficiency of the pilot project's implementation, with a focus on coordination among stakeholders (Section 5.3.1) and the project's engagement with community structures (Section 5.3.2). We also present the findings from our VfM analysis in Section 5.3.3, which focuses on issues of economy, efficiency, and cost-effectiveness.

5.3.1 Coordination among stakeholders

During the conceptualisation and design phase, most stakeholders (in particular, the MoE and KOSAP) felt that they were informed about the pilot project but were not actively involved in the design. Similarly, the solar suppliers stated that they were only involved in the project after the project had been designed and once they were selected, after responding to the request for proposals. The suppliers offered products that suited the project's specifications and explained the repayment mechanism to the project. Their business model/repayment terms were adapted for the project but the price remained the same as the market rate. Similarly, during the implementation phase, most stakeholders (besides Sida, UNICEF, and the implementing consortium) felt that they were only informed about the implementation, rather than actively involved in it. While the MoE felt that it could be more involved, the SPS and DSA felt they were involved on the ground through their officers (i.e. children's officers, etc.).

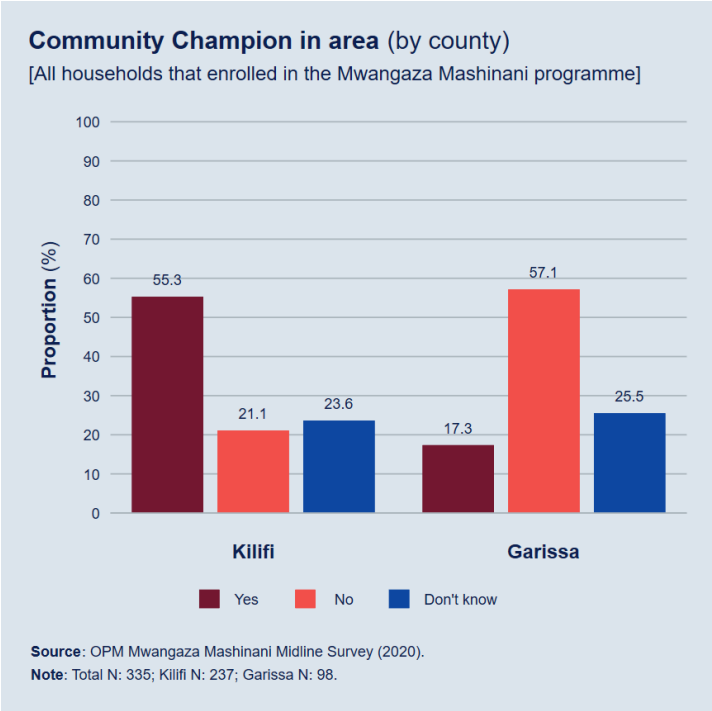
During the implementation review, stakeholders agreed that the county technical working groups are well attended and active. There is a general feeling that the county governments have been very supportive of the pilot project and that there is good political buy-in, which increased once the devices were distributed. However, stakeholders felt that the national technical working group has been less active and engaged. One stakeholder felt that there is a tension between the national technical working group, which receives a lot of pressure to implement quickly, and the county technical working groups, which are more detail-oriented and hence want to move slowly, to avoid implementation errors, the consequences of which would be felt in the counties.

5.3.2 Engagement with community structures

The pilot project has been implemented using local structures that are also part of the Inua Jamii. These include government structures, such as chiefs and children's officers, and structures of the Inua Jamii, including BWCs. While stakeholders interviewed as part of the implementation review were generally positive about the role of the BWCs in implementing the project and supporting beneficiary households, there are some concerns that the BWCs might not have the capacity (in terms of time availability and training) to fully take over the project were the implementing consortium to withdraw.

The project has also set up its own structures, including solar peer associations and CCs, with the aim of embedding the project in the communities. The CCs receive a small stipend and are able to earn a small income through the maintenance of devices or becoming agents for the solar suppliers. The midline survey found that the majority of households are not aware of the CC in their area. Among the households that received the solar device, less than half (44%) reported that there is a CC in their area, while 32% said there is no CC in the area and 24% did not know whether there was a CC in the area. There are county-level differences in the awareness of the CC. More households in Kilifi cited that there is a CC in their area, compared to households in Garissa (38 percentage points), as shown in Figure 11.

Figure 11: CC in area (by county)



When households do know the CC, they frequently contact them and raise issues with them. Among those who said there is a CC, the majority either contacted the CC once per month (28%) or more frequently, once every two weeks (23%), or even once every week (23%). A very small proportion (4%) reported not having contacted a CC at all.

Overall, the CCs' role was most commonly reported to relate to the provision of information to beneficiaries (55%), support on technical issues related to the solar device (47%), and representation of beneficiaries collectively (33%). A large proportion of households who were aware of the CC (87%) cited having raised an issue with CC. In this regard, CCs were considered to be very helpful (74%), while only a small proportion of households did not consider this interaction helpful (9%).

At midline, households were asked who they consider the main organisation leading the Mwangaza Mashinani pilot project to be. Almost half of all households (48%) reported that they did not know who was leading the project. A fifth reported the GoK as the main organisation behind the project, while 12% reported the solar providers (d.light or BioLite). 8% reported UNICEF and another 8% reported the Inua Jamii. There are significant differences across counties. While 53% of households in Kilifi do not know who the main organisation is, this is markedly lower in Garissa (37%), where more households reported the GoK (by 33 percentage points) and UNICEF (by 13 percentage points). On the other hand, more households in Kilifi reported the solar providers (by 16 percentage points) and Inua Jamii (by 10 percentage points). There were no significant differences across gender of household head or type of cash transfer.

5.3.3 VfM of the pilot project

5.3.3.1 Economy

From an economy perspective, the pilot project meets the definition of 'good'. This judgement considers the economy performance of the *pilot* project, which may be expected to carry forward for the expected economy of a scaled up programme, provided robust procurement procedures are maintained. There would even be scope for improving expected economy performance in the scaled up programme, if (for example) the cost for contractual services can be contained and/or the price of solar devices can be reduced going forward.

The project has managed to minimise the transaction costs attached to the cash transfers (M-Pesa charges and banks' charges), as well as staff and operational costs. However, contractual services cost more than expected. Some reasons for this relate to delays in the procurement practices and challenges emerging from contextual factors, some of them unforeseeable at the planning stage (for example, the effects of the COVID-19 pandemic or security issues emerging in Garissa). In other cases, poor underlying assumptions during the planning and costing process seem to explain the observed extra costs. For example, the project likely underestimated the resources necessary to operate in the targeted counties and the risks associated with piggybacking on the government's systems for the project's operations. This led to overspending for targeting households, underestimation of transport costs and costs for engaging with county government officials.

While the project followed sound procurement practices for the selection of the solar suppliers, the final cost of the solar devices was above the budgeted amount. In addition, beneficiaries experienced several issues in activating and repaying the devices (see Section 5.2.4), raising concerns about the suitability of the selected devices within the context of this pilot.

The functionality of the solar devices is relevant to economy insofar as this is an indicator that the devices purchased by the project are of adequate quality and are appropriate for the context in which they are used. As discussed in Section 5.5.2, at both midline and endline, 15% of beneficiary households reported that their device was not working at all. A further 17% of households reported that their device was only partially functional at endline, up from 14% at midline. Furthermore, for the households reporting non-functional devices at endline, the devices have not been functional for a long time – around six months on average. The relatively high proportion of faulty devices potentially indicates that more attention needs to be paid to device quality and hardiness when purchasing additional devices under subsequent phases of the project.

5.3.3.2 Efficiency

From an efficiency perspective, the pilot project is assessed as meeting the definition of 'average'. The project allocated significantly larger resources to set-up and inception activities, as well as implementation, compared to the budgeted amounts. Overspending was partially due to delays in the procurement practices, which increased overhead costs, issues in conducting the vulnerability assessment and adapting the design of the project to respond to the effects of the DSA migration and recertification process, and coordination of the repayment exercises. While some design adjustments are expected in a pilot project, a more proactive management, and a better risk mitigation strategy, would have reduced overspending.

Despite the initial delays, by June 2020, most of the logframe targets had been achieved. However, the project only partially succeeded in retaining beneficiaries, with 30% of households not regularly repaying the device, compared to an expected repayment rate of 100%. The attrition rate is quite high and presents the project with some lessons for subsequent phases.

The pilot cost nearly US$ 1.2 million to support 1,692 households purchasing a solar device, out of 2,175 households enrolled. This comprises about US$ 255,000 of cash distributed to recipient households, and about US$ 942,000 spent on expenses related to the provision of complementary services to beneficiaries, as well as administration and evaluation of the project. These complementary services include skills training and BCC relating to owning and managing the solar devices and improving the learning performance and health of beneficiary children. The observed spending reflects the learning objective of the pilot, and its intention to test an innovative approach to improving access to energy for the poorest segment of the population.

In the second phase of the project, the goal is to spend more on solar lanterns. There will therefore need to be an emphasis on increasing efficiency while scaling up. Alternative delivery models could also be explored as part of the second phase, and careful consideration should be given to which parts of the Inua Jamii delivery systems to piggyback on.

A final concern is that the project lacks a solid management information system (MIS); some cases of data inconsistencies and data gaps were observed. This makes knowledge management more cumbersome and less efficient, and limits effective tracking of beneficiaries and adaptive learning.

Despite these concerns, our assessment is that the expected efficiency of the programme at scale has the potential to be 'good', provided the following conditions hold:

- The programme takes measures to increase the percentage of enrolled households that follow through to purchase the solar device.
- The programme takes measures to increase the percentage of beneficiaries that regularly make repayments for the device (i.e. reducing the incidence of default). To the extent that default rates are caused by payment delays, measures should also be taken to support the Inua Jamii to minimise payment delays.
- Implementation of the scaled up programme is taken on by government agencies, and this brings down the cost of targeting and the community-level activities: for example, by piggybacking on existing government targeting and/or community support structures.
- The design of the targeting process under the scaled up programme is streamlined. This could include efforts to identify eligible households that are most likely to follow through to purchase the solar device after enrolment.
- Beyond the targeting process, community-level activities under the scaled up programme can be streamlined, hopefully in line with a growing market for solar devices, coupled with greater access to maintenance services.
- Direct technical assistance and quality assurance is no longer required from UNICEF and E4I, or is required to a much lesser extent as the programme is handed over to the government.

Meeting these conditions will be challenging, requiring some significant shifts from the current set-up and performance of the pilot project. It will therefore require deliberate attention and effective actions by UNICEF and other key stakeholders.

5.3.3.3 Cost-effectiveness

From a cost-effectiveness perspective, the pilot project meets the definition of 'average'. There are certain impact areas – such as education, child time use, and energy savings – that in the long run will benefit from the investments in the project when considering an implementation period of three years, as well as the extended use of the solar devices during its lifespan.

Based on available evidence, the project meets the definition of 'average' in regard to the cost-effectiveness of its education impacts. Excluding pilot-related costs, it is estimated that the cost of the project requires US$ 11.40 to be consumed to increase attendance in school for one child by one day. When compared to the benchmarks of other programmes that calculate the additional years of education delivered per child per US$ 100 spent, the Mwangaza Mashinani project fares better than most, including cash transfer programmes. This supports evidence from the impact analysis (Section 5.4.2) that shows that the project has led to an increase in hours of study, regular school attendance, and the number of students graduating to the next level. These benefits to the community will not only help to improve the level of education within the community, and possible income in the economy, but will also help in the fight against child labour, poverty etc.

On the other hand, the project meets the definition of 'low' in terms of cost-effectiveness concerning children's time spent studying at home. It costs US$ 2.30 to increase the study time for one child by one hour at night. The benchmark used is the alternative of providing private education/tuition to the students. Data from the teacher platform[33] indicate that the median hourly pay for a tutor in Kilifi and Garissa counties is US$ 2.84 per hour to educate children privately. Assuming that studying alone generates half the benefit of studying with a tutor, we calculate the benchmark to be US$ 1.42, which is lower than the cost of the project.

In the area of energy use, the project meets the definition of 'good'. Households in the project are benefiting from an average of 3.4 hours of extra energy use per day. The cost-effectiveness indicator indicates that it costs US$ 0.13 for one extra hour of energy using solar devices as an extra source of energy. Our benchmark of using mini-grids as an alternative source of renewable energy is US$ 0.23 per hour, which is higher than the cost of the Mwangaza Mashinani project. There are additional potential benefits of shifting to renewable energy sources that have not been captured and that are outside of the scope of this current analysis. A study of the cost savings in regard to CO_2 emissions would certainly help to further support the cost-effectiveness in terms of energy use.

Further, the fact that the solar devices afford households the opportunity to charge their mobile phones at home instead of paying to have their devices charged has been beneficial. Not only are the households able to charge their own devices, but some households have gained an additional income-generating activity through charging the mobile devices of their neighbours. Endline survey results show that up to 17% of households enrolled in the programme are engaged in this activity. For households paying to charge their mobile device, the price of charging a mobile has fallen by 43% at endline to KSH 14 per charge.

The endline survey results do reflect some impact areas that have not benefitted from the project, in particular health. As discussed in Section 5.4.4, this is likely because households' cooking habits remain a primary contributor to exposure to indoor air pollution.

[33] See www.teacheron.com/ for more information.

5.4 Impact

Box 6: Summary of findings related to impact

Overall, the Mwangaza Mashinani pilot project has had positive and significant impacts on households' access to improved energy and reduced use of more polluting and less reliable sources of lighting, and on children's study hours and education participation outcomes. Additionally, the project has had unintended positive effects on beneficiary households' social well-being. On the other hand, we find that the pilot project has had no impact on households' livelihoods and the health of household members, and this was expected at baseline. Households' perceptions on how the solar devices improve their lives are in line with the evidence from the endline impact estimation.

- **Energy access and expenditure:** The majority of households at endline are using solar energy for lighting. As a result, the pilot project has had a positive and large impact on households' access to better and more reliable energy for lighting, on their reduced reliance on other more polluting and lower-quality sources of lighting, and on their reduced spending on energy for lighting and charging mobile phones.
- **Prevalence and awareness of solar energy:** Awareness of the benefits of solar energy among beneficiary households at endline is extremely high and has improved over time. There is also evidence of market creation effects of the project: the penetration of solar devices in the surveyed treatment and comparison communities has increased markedly over time.
- **Use of solar devices and unintended positive effects:** Households use the solar devices on a daily basis, mostly for supporting children's study time, using them for productive unpaid activities, charging mobile phones, and providing light for security and socialisation. The use of the solar devices has also had unintended positive effects on beneficiary households' social well-being, including a better sense of security provided by light at night, staying connected by having charged mobile phones and radios, and improved social capital within communities.
- **Children's time use:** The pilot project has had a positive and significant impact on the number of hours children spend studying outside school, and in particular at home during dark hours. Girls and boys spend equal amounts of time per day studying. The majority use the solar home system to study during dark hours.
- **Education:** The pilot project has had a positive and significant impact on children's school attendance and promotion to subsequent academic grades. There is no evidence of an attributable impact on the proportion of children regularly attending school.
- **Livelihoods:** Despite an increase in the number of working household members and the number of productive activities households are engaged in over time, there is no evidence that the pilot project has had an attributable impact on these outcomes or on households' monthly income. At midline, we found a modest positive impact of the project on the number of working members and productive activities. However, this mid-term impact has not been sustained at endline.
- **Women's time use:** While women are spending more time on productive activities – and specifically unpaid labour – compared to baseline, and over half are using solar devices to conduct their productive activities during dark hours, there is no evidence that the pilot project has had an attributable impact on how women allocate their time to different activities. Reassuringly, we do not find unintended detrimental impacts on women's time poverty.
- **Health:** While the prevalence of symptoms of eye irritation and burns related to lighting fuel among household members has decreased over time, to reach very low levels at endline, there is no evidence that these improvements in health outcomes can be attributed to the pilot project. Households' cooking habits remain a primary contributor to exposure to indoor air pollution.

This section provides key findings on the impacts of the Mwangaza Mashinani pilot project two years since the start of implementation and almost a year following the conclusion of its first phase. We present results related to households' energy access and use (Section 5.4.1), children's time use and education (Section 5.4.2), household livelihoods and women time use (Section 5.4.3), and household

members' health (Section 5.4.4), as per the impact areas defined in the project's ToC (see Figure 47 in Chapter 6).

This section primarily draws on quantitative data from the baseline, midline, and endline surveys. This is because, as mentioned in Section 4.3, the qualitative research was conducted in early 2020 and therefore does not explore the impact of the project.

Specifically, for each impact area, we present descriptive trends over time and impact estimates. We investigate the change in selected outcomes between baseline and endline – and where possible midline – and how much of these changes can be attributed to the pilot project. We also present descriptive results disaggregated across categories of interest, such as the location of the household (i.e. county), the gender of the household head or household member, the age of the household member, and the cash transfer programme in which the household is enrolled. It is worth noting that, firstly, two-thirds of sampled households reside in Kilifi and one-third reside in Garissa; and, secondly, there are some correlations between the different disaggregation factors. Specifically, more female-headed households are enrolled in the CT-OVC (61%) compared to male-headed households (30%) and vice versa for the proportion of female-headed and male-headed households enrolled in the OP-CT. Furthermore, more female-headed households reside in Kilifi than in Garissa (a difference of 7 percentage points), though the difference is only weakly significant. Finally, it should be noted that impact estimates are not presented separately by sub-groups due to sample size considerations.

When it comes to the descriptive trends, the quantitative results discussed in this section are broadly the same across households in the original evaluation treatment group (that is, all households intended to be treated) and the sub-sample of households that were actually treated. Therefore, in what follows, we present the estimates for the former group (intended beneficiaries) only. Where findings differ for the sub-sample of households that were enrolled in the project, this is discussed. As for the impact results, both ITT and ATT impact estimates are discussed in this section, as defined in Section 4.2; however, the graph for the ATT estimates is only shown where there is a large difference between the ITT and ATT estimates – otherwise, it is included in Volume II, Annex E.

5.4.1 Energy

5.4.1.1 Energy access and expenditure

Energy access and expenditure for lighting

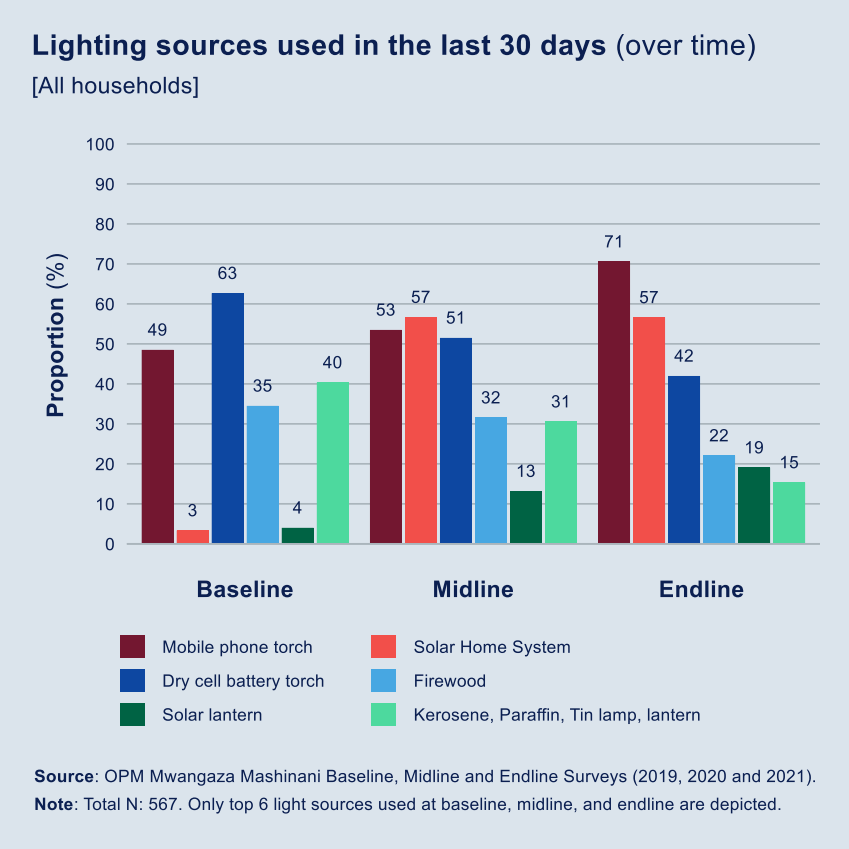
At endline, the top six reported sources of energy used by households for lighting in the 30 days preceding the survey include mobile phone torch (71%), solar home system (57%), dry-cell battery torch[34] (42%), firewood (22%), solar lantern (19%), and kerosene, paraffin, tin lamp, or lantern (15%) (Figure 12). Overall, two-thirds of households used solar energy for lighting, which primarily includes solar home systems but also solar lanterns and solar torches (Figure 13).

There have been significant changes over time in the sources of energy households rely on for lighting (Figure 13 and Figure 14). Since baseline, there has been a marked increase of 57 percentage points in the usage of solar sources, as would be expected following the Mwangaza Mashinani intervention. Specifically, at endline, considerably more households cited usage of solar home systems (by 53 percentage points) and solar lanterns (by 15 percentage points) for lighting compared to baseline. Since midline, there has been no significant change in the use of solar home systems but there has been an increase in the use of solar lanterns. The increased use of solar lanterns is driven by households who own other solar devices besides the one provided by the pilot project (see Section 5.4.1.2 on ownership of other solar devices). There has also been an increase in the use of mobile phone torches for lighting since baseline (by 22 percentage points), which may be explained by the increase in mobile phone ownership (from 83% at baseline to 94% at endline). Interestingly, 5% of

[34] This includes home-made torches where a bulb is connected to a circuit of batteries, resembling a torch.

households at endline reported using the national grid (these households reside primarily in Garissa), compared to none at baseline, which was due to the project's targeting criteria.

Figure 12: Lighting sources used in the 30 days preceding the survey (over time)



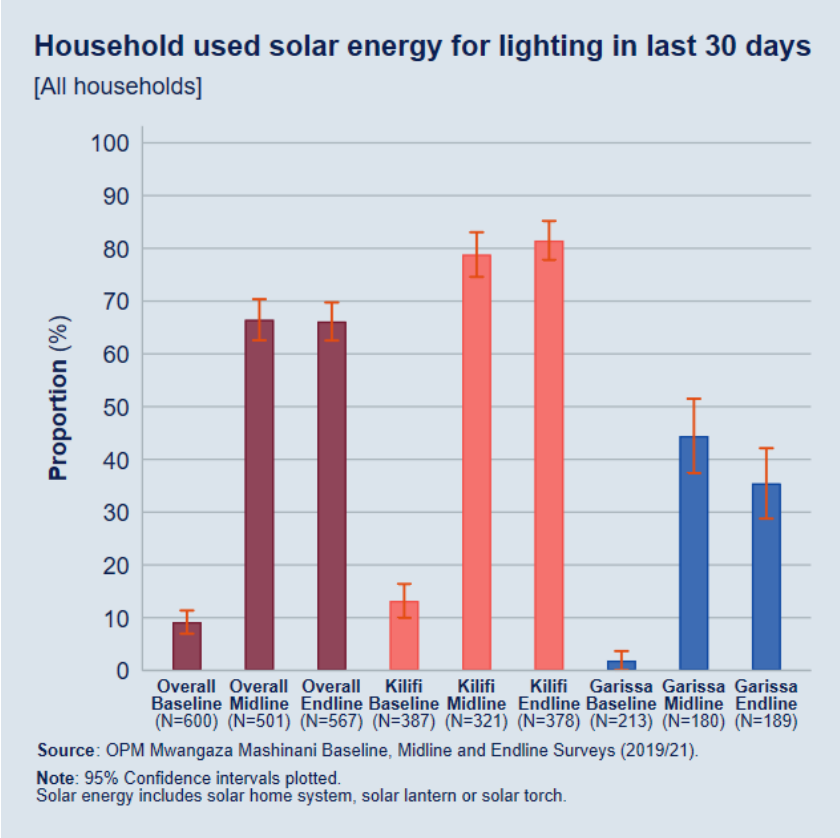
Source: OPM Mwangaza Mashinani Baseline, Midline and Endline Surveys (2019, 2020 and 2021).
Note: Total N: 567. Only top 6 light sources used at baseline, midline, and endline are depicted.

On the other hand, households have gradually reduced their reliance on other sources of lighting over time. While 63% of households used dry-cell battery torches at baseline, this declined to 52% at midline, and then further to 42% at endline. Similarly, the use of kerosene for lighting has declined from 40% of households at baseline to 31% at midline and 15% at endline. The use of firewood has also declined from 35% at baseline and 32% at midline to 22% at endline.

As expected, these trends are stronger among households that actually enrolled in the project, with 79% using solar energy for lighting at endline. While this high prevalence constitutes a marked increase of 70 percentage points since baseline, it shows that 20% of households with a solar device had not used it in the 30 days preceding the survey. These are primarily households who no longer have the solar device provided by the project or whose device is not fully functioning (see Section 5.5.2). These findings suggest that when households have a functioning solar device, they are using it and they are reducing their use of other lighting sources.

There are stark differences between counties regarding the use of some sources of energy for lighting. As shown in Figure 13, the use of solar lighting at endline is much more prevalent among households in Kilifi (82%) compared to those in Garissa (35%). Even among households that enrolled in the project, only 53% in Garissa used solar lighting in the 30 days preceding the survey, compared to 90% in Kilifi. The use of kerosene for lighting is almost entirely driven by households in Kilifi (23%), compared to almost zero in Garissa. On the other hand, the use of dry-cell battery torches is much more common in Garissa (70%, compared to 28% in Kilifi), and while 13% of households in Garissa reported relying on the national grid, almost none in Kilifi did. Furthermore, we find that male-headed households are more likely to use dry-cell battery torches and firewood as sources of lighting compared to female-headed households (by 17 and 11 percentage points, respectively). We find no significant differences by the type of cash transfer.

Figure 13: Solar lighting used in the 30 days preceding the survey (by county and over time)

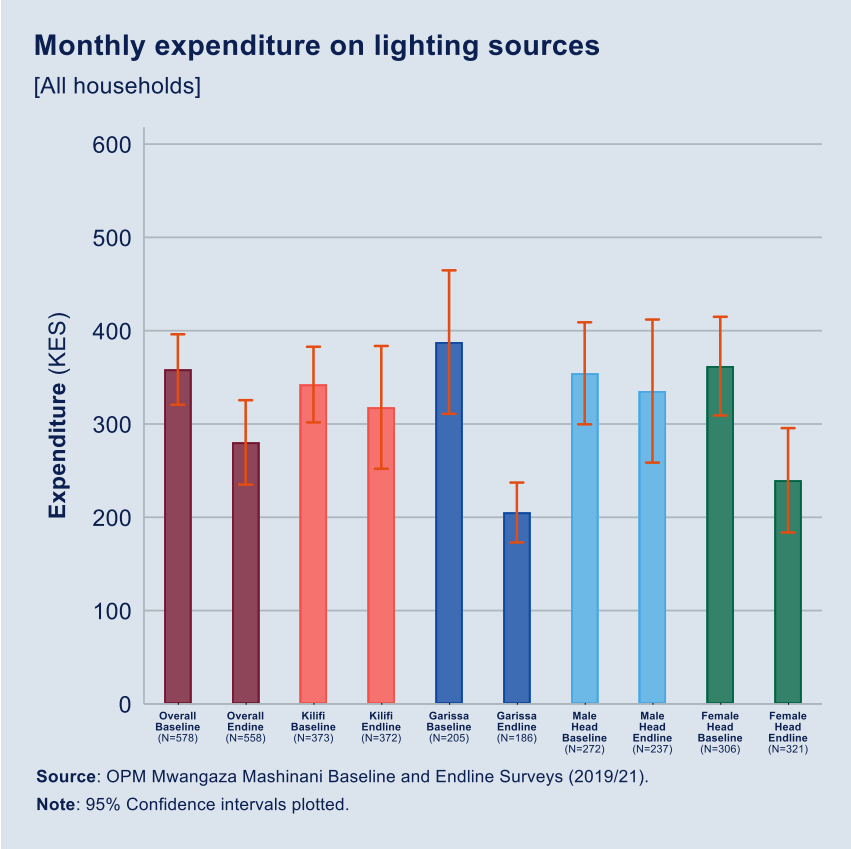


In terms of expenditure on lighting at endline, households spent on average KSH 280 on all lighting sources in the month preceding the survey (Figure 14).[35] This has decreased significantly since baseline, when average expenditure on lighting was KSH 358. This reduction seems to be driven in large part due to households' reduced reliance on non-solar lighting sources since baseline. Among the sub-set of households that used kerosene and dry-cell batteries at both points in time, the expenditure on these sources was similar at baseline and endline. The only exception is for firewood where expenditure among households using this source decreased from KSH 185 at baseline to KSH 0 at endline. At baseline, while almost all households in Kilifi who used firewood for lighting were collecting their own firewood and not paying a fee for it, half of the households in Garissa who were using firewood for lighting were purchasing it while the other half were collecting it. By endline, all households using firewood for lighting across both counties are using their own freely collected firewood, as opposed to purchasing it.

On average, households reported spending KSH 180 on solar home systems in the month preceding the endline survey. However, this was lower among the group of households that enrolled in the project (KSH 77), and only a minority of households incurred any costs on solar home systems. Specifically, 93% of households that enrolled in the project did not spend any money on solar home systems in the month preceding the endline survey. Among the remaining 7% of households that incurred costs on solar home systems, on average they spent KSH 1,090 in the previous month, which is likely costs related to the maintenance of the device or to other solar devices owned by the household (see Section 5.4.1.2 on ownership of other solar devices). The total monthly spend on all lighting sources is also lower for the group of actually treated households, at KSH 210, compared to households in the intended to treat sample (KSH 280).

[35] This includes expenditure on candles, kerosene, dry-cell batteries, rechargeable batteries, solar lanterns, solar home systems, firewood, solar torches, and electricity from the national grid.

Figure 14: Monthly household expenditure on lighting sources (by county and gender of household head, and over time)



Despite more households in Kilifi using solar lighting, we find that households in Kilifi spent more on lighting energy (KSH 317) than households in Garissa (KSH 205). This difference is primarily driven by more households in Kilifi incurring costs on kerosene and solar home systems, compared to the few households in Garissa that use or spend on these two energy sources. OP-CT beneficiaries also spent more on lighting sources (KSH 348) than CT-OVC beneficiaries (KSH 216). There are no differences in the monthly expenditure on lighting by gender of the household head.

Multi-Tier Framework Classification for access to energy for lighting

In addition to measuring changes over time in households' access to different sources of energy for lighting, we also assess whether households have improved access to better-quality and more reliable sources of lighting. We follow the Multi-Tier Framework (MTF) approach to measuring quality of access to energy, where households are classified against six rising tiers in terms of their access to electricity for lighting. Box 7 explains how each tier is computed.

There has been a marked increase between baseline and endline in the proportion of households that have access to higher-tier levels of energy for lighting. While 98% of households at baseline fell into tier 0 for lighting, this has declined significantly to 56% of households at endline. On the other hand, 33% of households at endline fall into tier 1 for lighting and 12% fall into tier 2 for lighting. The proportion of households with access to higher tiers for energy is, as expected, even higher among the sub-sample of households that were actually treated: 41% of these households have access to the tier 1 level of energy and 15% have access to the tier 2 level of energy for lighting.

There are significant differences in access to higher tiers of energy across county, gender of household head, and type of cash transfer. While 54% of households in Kilifi at endline fall into tier 1 or above for lighting, only 24% of households in Garissa do. Furthermore, while 51% of female-headed households fall into tier 1 or above for lighting, only 34% of male-headed households do.

Finally, while 52% of CT-OVC beneficiary households have access to tier 1 or above for lighting, only 38% of OP-CT beneficiary households do.

Box 7: Computing the MTF for lighting

MTF, which is considered an industry standard, is used to measure levels of electricity access before and after the Mwangaza Mashinani pilot project. Household electricity access is classified against six rising tiers, with tier 0 representing no access to electricity and tier 5 classed as access to an affordable, legal connection to 24-hour grid power or its equivalent. These tiers can be thought of in terms of the increasing levels of energy services that can be provided at different levels of access to electricity.

Given the level of technology the Mwangaza Mashinani pilot project is supplying (very small solar home systems), and the existing household lighting technology encountered at baseline, we anticipated that the levels of access likely to be encountered before and after the project would be between tier 0 and tier 1 on this scale.

Measurement is made slightly more complicated because three or four bulb solar home systems may not provide sufficient lighting to merit a whole household (say five members) being classified as having a lighting service that meets tier 1 requirements. This is because the smaller home systems or lamps provide relatively low levels of light that limit their utility – you may have to be quite close to the light bulb to be able to use it for reading, for example, and, in so doing, may exclude someone else from being able to use the light for another purpose. The solar home systems also come with points for charging mobile phones. If used, this will provide additional services (phone charging) but further limit the utility of the lighting (as it utilises battery power from the lamp).

Tier 1 requires a lighting system to provide 1,000 lumen-hours of light for a household of five persons, and requires access to a modern and clean source of light.[36] Many of the cheaper solar home systems will not provide this level of light and so it is necessary to calculate an equivalent number of people, rather than households, that can be said to have access to a tier 1 level of energy as a result of the project. This number will likely be less than the total population of the households that acquire solar home systems. Tier 0 therefore measures the proportion of the population with no access to modern sources of light or who have access to a modern source of light but whose electricity tier level is below 1.

The lumen output of existing lighting systems encountered in the baseline and endline surveys was assessed based on the relevant manufacturer's published technical data or matched to an equivalent known product when the manufacturer's name or data were not available.

A technical methodology for assessing the equivalent number of people achieving a tier 1 access is given in Volume II, Annex J.

Energy access and expenditure for charging mobile phones

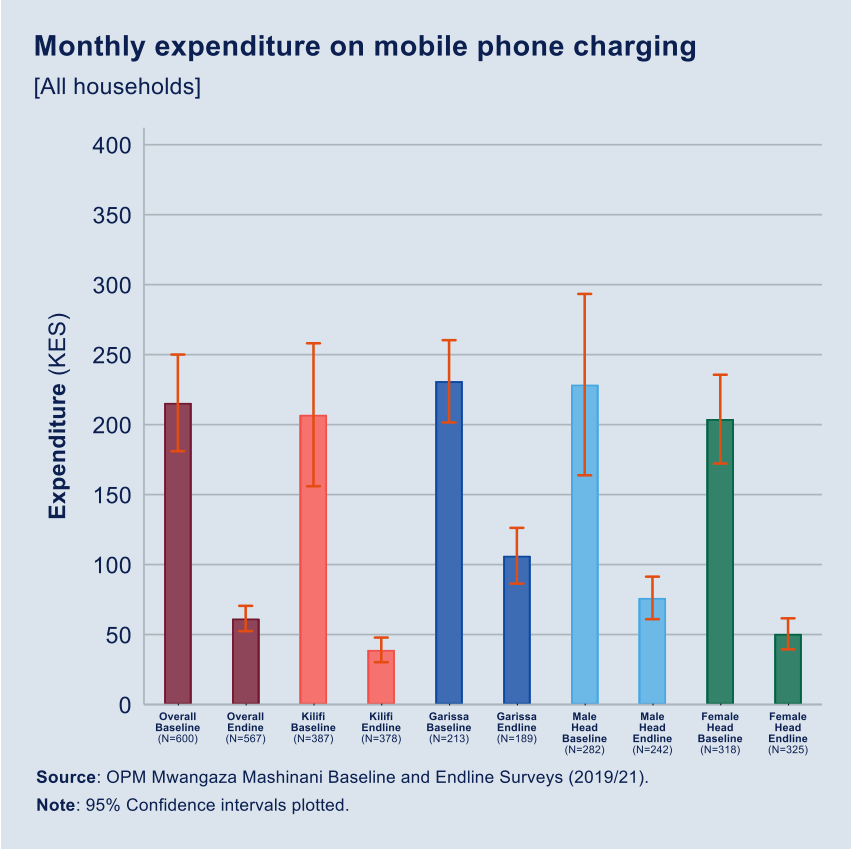
Similarly to measuring access to energy for lighting, households are classified on a tier basis in terms of their access to energy for charging phones. Households that have the capacity to keep their phone continuously operational by charging the device in their own home are classified as having tier 1 access. Households that have to charge their phone outside the house are classified as having tier 0 access.

There has been a marked increase in the proportion of households with a mobile phone that have tier 1 access to energy for phone charging, from only 7% at baseline to 57% at endline. This is owing primarily to the ability of households to charge their mobile phones using solar home systems in their homes. The proportion of households with tier 1 access to phone charging is even higher, at 72%, among the sub-sample of households that enrolled in the project (up from 8% at baseline).

[36] In this context, LPG (gas) lamps, biogas lamps, solar lanterns, solar home systems, mini-grids, the national grid, and generators are considered modern sources of light. However, based on the data from the endline survey, no households use LPG lamps, biogas lamps, or generators, or have access to a mini-grid, and a very small minority have access to the national grid. Consequently, only households owning solar devices may fall into tier 1 for lighting.

Amongst households with tier 0 access to phone charging, 74% are able to charge their phones within 500 metres of their dwellings, an increase of 19 percentage points from baseline. The average fee for charging a mobile phone has decreased from KSH 25 per charge at baseline to KSH 14 at endline. The fall in the average fee and the improved ability to charge phones closer to home may be a result of the growth in supply of phone charging owing to the increased prevalence of solar home systems in the surveyed communities.

Figure 15: Monthly household expenditure on charging mobile phones (by county and gender of household head, and over time)



On average, households at endline spend KSH 61 per month on charging their mobile phones, a considerable decrease from KSH 216 at baseline (Figure 15). This reduction of KSH 154 between baseline and endline is in large part due to the rise in the proportion of households charging their phones at home at endline, but also due to the fall in the average fee per charge.

Households in Garissa spend significantly more on phone charging per month (KSH 106) than those in Kilifi (KSH 39). This is driven by two factors: first, fewer households in Garissa have tier 1 access to phone charging (36% in Garissa versus 68% in Kilifi), and second, the average fee per charge is higher in Garissa (KSH 16 in Garissa versus KSH 13 in Kilifi). Male-headed households also spend KSH 26 more on phone charging per month than female-headed households.

Combined together, households' total expenditure on energy sources for lighting and mobile phone charging at endline averages KSH 341 per month. This is a marked decrease of KSH 231 since baseline, when average total spending was KSH 572. This reduction is even more pronounced among the group of households that enrolled in the project and that saw their total monthly spending on lighting and charging mobile phones decline to less than half what it was at baseline (KSH 253 at endline, down from KSH 577 at baseline).

Energy access and expenditure for cooking

In terms of cooking, the overwhelming majority of households cook using a traditional stone fire (95%), with firewood as the main source of cooking fuel (97%). This is the same as the situation at baseline.

In Garissa, the proportion of households using a traditional stone fire is slightly lower, at 87%, and instead 12% of households use a *jiko*[37] for cooking. This translates into slightly fewer households in Garissa using firewood as the main source of cooking fuel (92% versus 100% in Kilifi) and more households using charcoal (8% versus 0% in Kilifi).

On average, households spent KSH 160 on cooking fuel in the month preceding the survey at endline, which represents a reduction of KSH 81 from baseline spending. However, the differences across counties are striking. In Kilifi, 98% of households do not spend any money on cooking fuel as they collect their own firewood and hence average expenditure on cooking fuel in the month preceding the survey was only KSH 11. In Garissa, on the other hand, while a large proportion of households (62%) use their own collected firewood for cooking and do not pay a fee for it, the remaining 38% pay a fee for firewood such that on average households in Garissa spent KSH 460 on cooking fuel in the month preceding the survey, while this figure was KSH 1,218 among those households that pay for their cooking fuel.

There are no observed differences in cooking fuel use and expenditure based on gender of the household head or type of cash transfer.

Impacts attributable to the pilot project

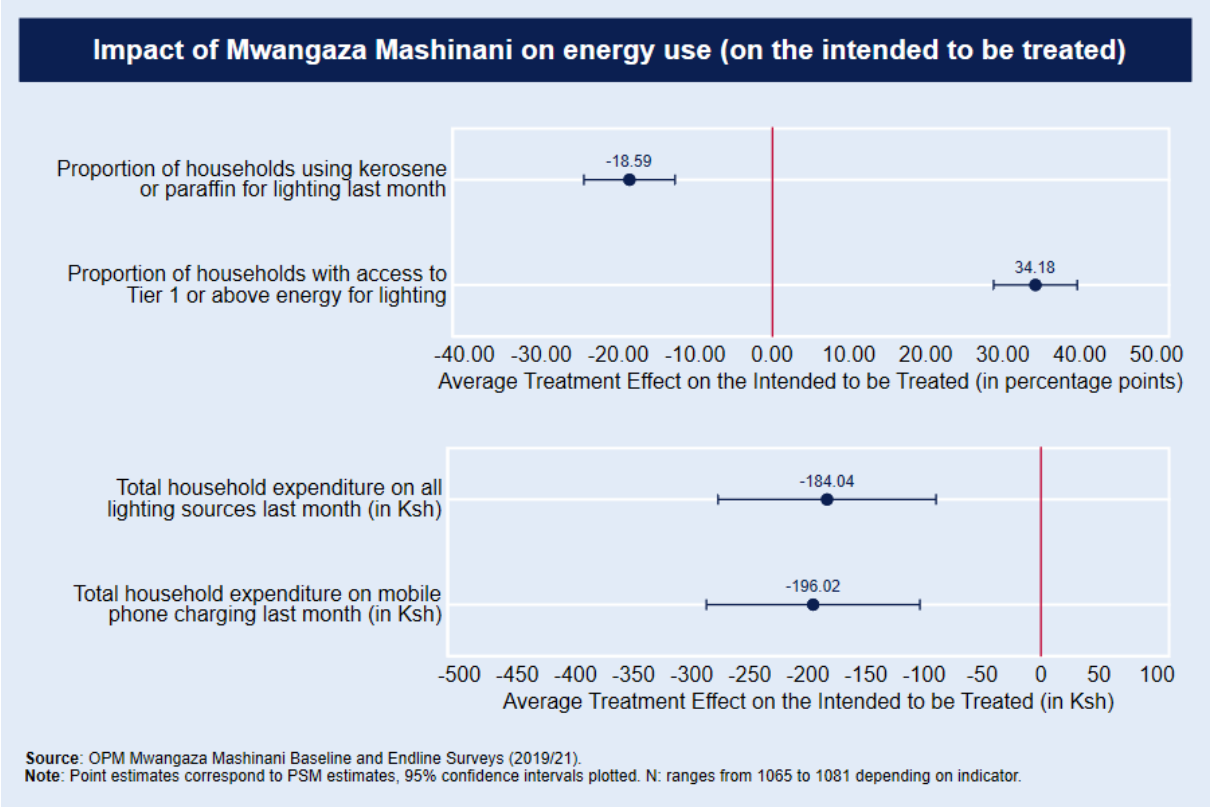
The reduction in households' reliance and expenditure on non-solar energy over time can in large part be attributed to the Mwangaza Mashinani pilot project (Figure 16). Among the sample of households intended to be treated, we find a sizeable impact of the pilot project on the proportion of households using kerosene for lighting (a reduction of 19 percentage points). Furthermore, we find that, among this sample, the project has reduced expenditure on energy for lighting by KSH 184 per month and reduced expenditure on charging mobile phones by KSH 196 per month. We also find that the pilot project has had a positive and sizeable impact on households' access to higher tiers of energy for lighting: it has increased the proportion of households with access to tier 1 or above for lighting by 34 percentage points. All of these estimates are highly significant at the 1% level.

The impact is equally substantial among the sample of households that were actually treated (see Figure 42 in Volume II): the project has reduced the proportion of households using kerosene for lighting by 20 percentage points, and reduced expenditure on lighting by KSH 255 per month, and expenditure on charging mobile phones by KSH 152 per month. The project has also increased the proportion of households with access to tier 1 or above for lighting by 42 percentage points. All of these estimates are highly significant at the 1% level.

The cost savings in regard to energy for lighting and charging mobile phones offered by the pilot project are equivalent to about KSH 400 per month. For the households enrolled in the project, this is a considerable cost saving that represents about 20% of their monthly Inua Jamii amount (Inua Jamii beneficiaries receive KSH 4,000 on a bi-monthly basis) and about 13% of their income at baseline from productive activities (see Section 5.4.3.3). The qualitative research at midline found that households use the money saved from not buying kerosene and from being able to charge their own phones primarily to buy food and school supplies.

Figure 16: Impact of the pilot project on energy use and expenditure (ITT)

[37] The *jiko* is a portable, charcoal-burning stove used for cooking which was developed to reduce fuel consumption.



Source: OPM Mwangaza Mashinani Baseline and Endline Surveys (2019/21).
Note: Point estimates correspond to PSM estimates, 95% confidence intervals plotted. N: ranges from 1065 to 1081 depending on indicator.

5.4.1.2 Prevalence and awareness of solar energy

Awareness of the benefits of solar energy

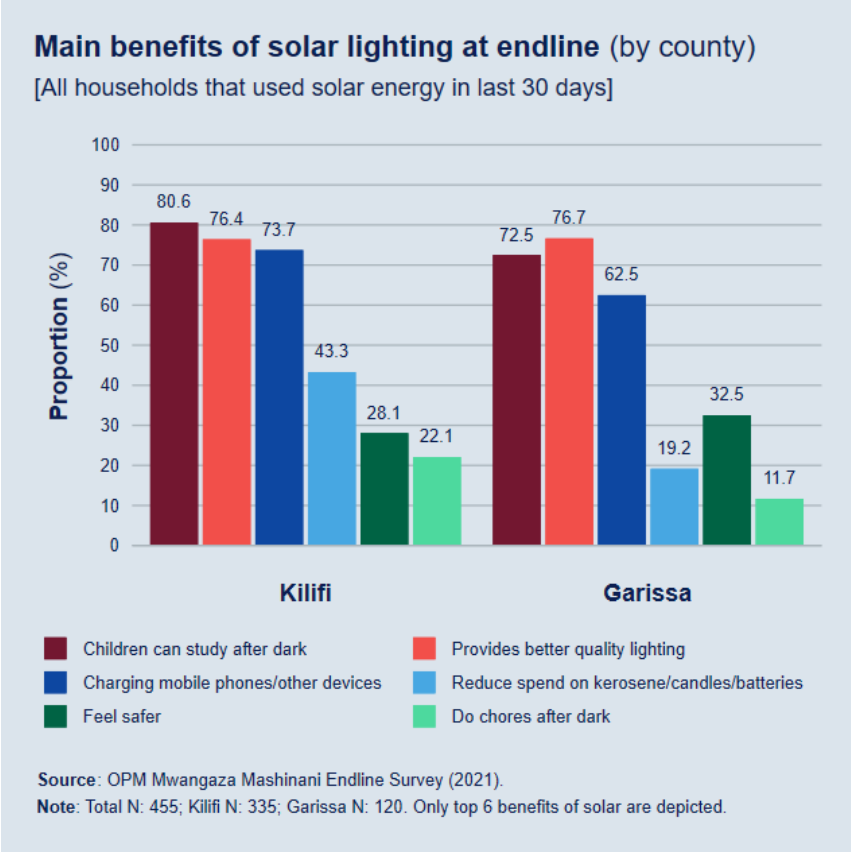
At endline, it is clear that there remains a high level of awareness of the benefits of solar energy solutions among households that use or own solar devices in both Kilifi and Garissa. Specifically, 100% of these households stated that they are aware of at least one benefit, while 99% reported awareness of more than one benefit. On average, households reported four to five benefits of solar lighting. This is an improvement from already high levels of awareness at baseline, whereby 84% of households using solar energy reported more than one benefit, and households cited on average two to three benefits.

The most commonly reported benefits of solar lighting sources among households that use solar energy include the following: allowing children to study when it is dark (79%); providing brighter, better, or more reliable quality lighting (77%); charging mobile phones, radios, or other devices (71%); reducing spend on kerosene, candles, or batteries (37%); and making household members feel safer (29%). Only 17% of households reported that a benefit of the solar device is allowing household members to do productive work during dark hours, and less than 10% reported benefits of solar lighting that are linked to improved health and environmental outcomes, and the ability to earn more money. Across the counties, we see some differences in the stated benefits of solar lighting, as shown in Figure 17.

Compared to midline, significantly more households at endline stated that a benefit of solar energy is providing better-quality lighting, allowing children to study when it is dark, and making household members feel safer. On the other hand, fewer households reported that one of the benefits of solar lighting is allowing household members to do chores when it is dark. These findings on households' perceptions of the benefits of solar lighting devices are well in line with the evidence from the endline impact estimation presented throughout this section. Specifically, the areas in which we find an attributable positive impact of the pilot project are those which households report as being the greatest benefits of solar lighting devices (i.e. increased children's study hours, improved ability to charge mobile phones, reduced spending on energy sources, and access to brighter and higher-tier energy

for lighting). On the other hand, the areas in which we do not find an attributable impact of the pilot project are those which few households report as being a benefit of solar lighting (i.e. improved health outcomes, increased hours of productive work, and increased household income).

Figure 17: Main benefits of solar lighting among users or owners of solar energy (by county)



The endline survey also points to a high level of general awareness of solar energy solutions and their benefits among households that do not own or use solar lighting (the majority of which comprise the households that were intended to be treated but did not end up enrolling in the project). This awareness has also increased since both baseline and midline. Specifically, 88% of these households are aware of solar energy as a source for lighting and 90% are aware of solar energy as a source for charging mobile phones. On average, these households report three to four benefits of solar energy and the top benefits are similar to those reported by households that use solar energy.

This increased awareness is also associated with more discussions around solar energy at the community level. At endline, 38% of households reported discussing the use and benefits of solar devices with other households in the community in the previous year, up from 22% at baseline. This increase is mainly driven by more frequent discussions in Kilifi, where 44% of households at endline engage in community discussions around the use and benefits of solar devices, up from 24% at baseline. On the other hand, only 23% of households in Garissa at endline engage in community discussions around the use and benefits of solar devices, up from 18% at baseline.

Furthermore, while there has been a slight decrease since baseline in the proportion of households that have been visited by someone promoting solar devices in the year preceding the survey (28% at baseline, down to 23% at endline), there has been a significant increase in the proportion of households that have been visited by an agent selling solar devices (from 23% at baseline to 37% at endline). These visits, conducted primarily by agents from the solar providers selling the products, seem to have occurred in 2020 but also throughout the first half of 2021, suggesting that providers have been continuously visiting the surveyed communities. The agents have been mostly selling solar home systems, but also solar lanterns and solar panels. In line with previous trends, Kilifi has had a

significantly higher proportion of households visited by someone promoting solar energy or selling solar devices than Garissa. These findings are in line with other evidence of market creation effects of the project which are presented in the subsequent paragraphs.

Increased prevalence of solar energy in the communities

The penetration of solar devices in the surveyed communities has increased markedly since baseline. While only 7% of households in the treatment sub-counties owned a solar device at baseline, at endline three-quarters of households are solar device owners. Further, a quarter of beneficiary households reported owning another solar device besides the one supplied by the project.

This increase in solar ownership has not only been limited to the project beneficiaries. In fact, of the households that were intended to enrol in the project but did not, 38% reported owning a solar device (presumably that they bought for themselves). The increased prevalence of solar device ownership has also been observed in the comparison communities (Table 4). While only 4% of households in the comparison sub-counties owned a solar device at baseline, 27% of households at endline own a solar device. This significant increase in the uptake of solar devices in the comparison group may be the result of a positive spill-over of the pilot project.

Table 4: Prevalence of solar device ownership in comparison communities, by county and over time

Indicator	Baseline	Midline	Endline
Proportion of surveyed households in the overall comparison sub-counties that own a solar device	4%	18%	27%
Proportion of surveyed households in the Kilifi comparison sub-counties that own a solar device	6%	26%	36%
Proportion of surveyed households in the Garissa comparison sub-counties that own a solar device	0%	6%	7%

While on the whole this points to very positive results for the project, there remain significant differences in regard to the penetration of solar energy across counties. Ownership of solar products was much more common among households in Kilifi than in Garissa across all groups (i.e. those that enrolled in the project, those that did not enrol in the project, and those in the comparison sub-counties).

Among households in the treatment sub-counties that were not enrolled in the project and did not use solar energy, 78% expressed an interest in buying a solar device. The main reason cited for not wanting to buy a solar device, or not having bought one already despite wanting to, is the costs of the solar products. This, coupled with the fact that households have high levels of awareness of solar energy and its benefits, confirms the finding reported in Section 5.1.1 that the main reason why beneficiaries had not acquired a solar device prior to the project was not being able to afford the payments, rather than a lack of knowledge about the benefits of solar energy or where to acquire solar devices.

5.4.1.3 Use of solar devices and their effects on quality of life

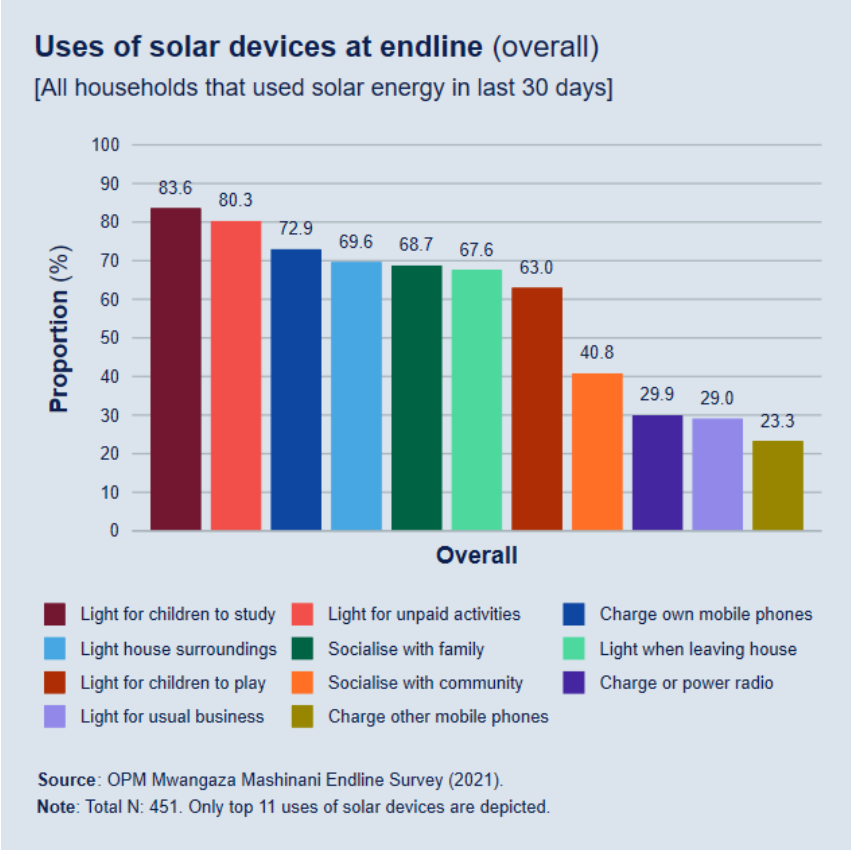
Use of the solar devices

As mentioned in Section 5.4.1.1, the overwhelming majority of households that have a functioning solar device had used it as a source of lighting in the month preceding the survey. Of the households with solar energy, 95% reported using the solar devices every day or most days of the week. On average, households use the solar devices for 11 hours per day.

The qualitative research at midline found that it is often the beneficiary who is enrolled in the Inua Jamii (the owner of the device) who determines when and by whom in the household the device should be used. Qualitative findings suggest that most households deem that, despite its various uses,

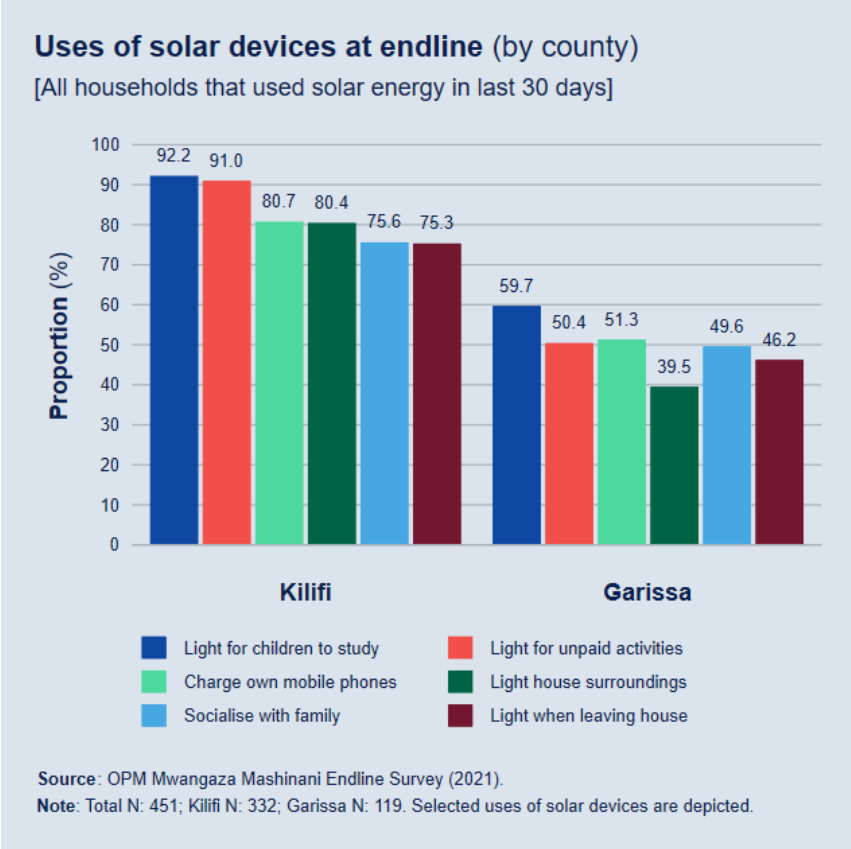
the greatest benefit of solar device use is for their children, especially in terms of increasing study hours at night and early in the morning before school. Households reported that children have more time, and better-quality time, to study as they are not disturbed by low light or smoke caused by alternative lighting sources, such as torches and kerosene. Respondents reported no differences in the way girls or boys use the solar devices, but rather that now all children can study and get ready for school together due to the better-quality light. In addition, qualitative findings indicate that the solar devices better enable women to cook at night, as well as to bathe children in the morning and to prepare their meals before they go to school.

Figure 18: Main uses of solar devices (overall)



These findings are corroborated by the endline survey results, where we find that the most common uses of solar devices among households that use solar energy include the following (Figure 18): lighting for children to study (84%); lighting to work on unpaid activities (80%); charging the mobile phone of household members (73%); lighting the surroundings of the house (70%); lighting the house in the evening for household members to socialise and hang out (69%); lighting for when household members leave or enter the house (68%); and lighting for children to play (63%). While the top uses of the solar devices at endline are similar to those at midline, there have been some changes over time. Compared to midline, more households at endline are using the solar devices for working on unpaid activities and for lighting the way when members leave or enter the house at night. On the other hand, fewer households are using them for charging their phones and those of other households, for charging or powering the radio, and for working on paid activities. This may suggest that there is a short-term effect on the use of solar lighting devices for certain activities.

Figure 19: Main uses of solar devices (by county)



There are significant differences in the use of solar devices across the counties. Households in Kilifi use the solar devices for more hours per day (13 hours, compared to six hours in Garissa). Additionally, more households in Kilifi reported each use of the solar device, compared to households in Garissa (Figure 19). While over 90% of households in Kilifi use the solar devices for children's studying and work on unpaid activities, less than 60% of households in Garissa do so. There are no significant differences by gender of household head or cash transfer type.

Unintended positive effects of the solar devices on quality of life

The evaluation has found that the solar devices have improved the quality of life of beneficiary households in other areas not necessarily targeted by the project's ToC.

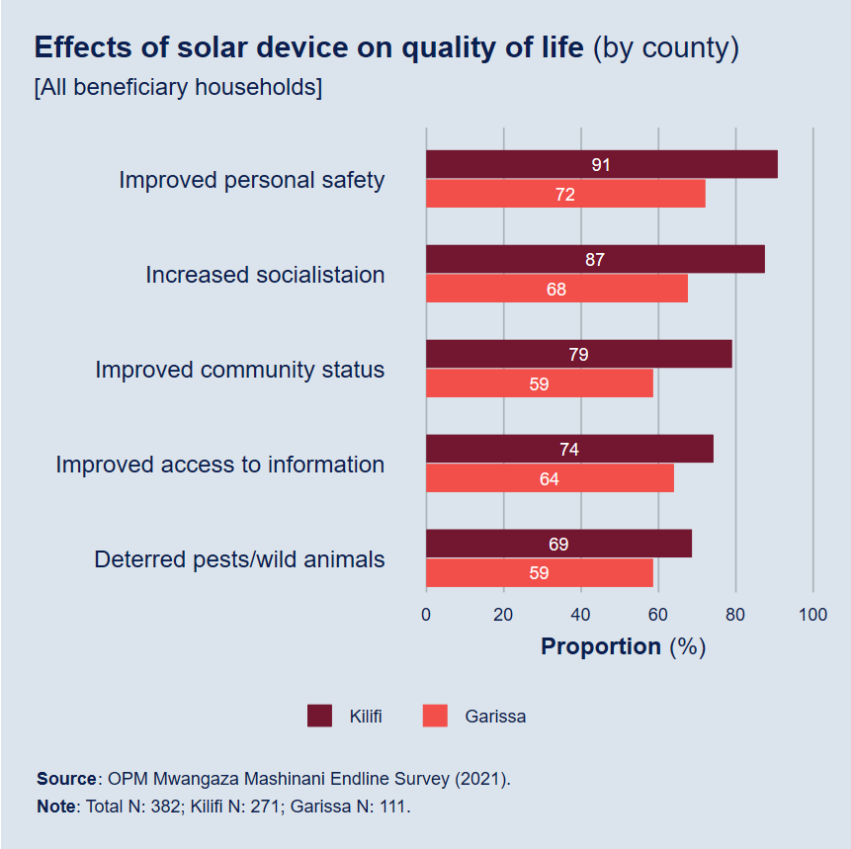
Qualitative findings from midline suggest that in addition to saving money, being able to charge mobile phones more frequently at home and using the radio has meant that households are better able to stay connected with each other and with what is happening in other parts of the country and the world. Households can also save time as a result of not needing to visit other households or travel to vendors in nearby towns to charge their phones, particularly if they live in remote villages.

It was also found that the solar devices provide security against theft of belongings and livestock, and safety against snakes or other wild animals that are put off by the light. Furthermore, there is also a sense that households with a solar device have a greater social standing as a result of increased time spent socialising and relaxing outside their homes.

The endline survey results validate these findings from the qualitative research, with the majority of beneficiary households reporting that the solar devices have improved certain aspects of their lives. Specifically, 85% of households reported that the solar device has improved the personal safety of household members, 82% reported that the solar device has improved opportunities to communicate and socialise with other households in the community, 73% reported that the device has improved their status in the community, 71% reported that the device has improved their access to general information concerning politics, government policies, society, health, rights etc. (which is important in the context of the COVID-19 pandemic and keeping up to date with public health information and

lockdown measures), and 66% reported that the device has deterred the presence of pests or wild animals at night surrounding the household. Almost no households reported that the device has had a negative effect on any of these aspects, with the exception of 17% of households that reported that the device has attracted the presence of pests at night.

Figure 20: Unintended positive effects of solar device on quality of life (by county)



While the majority of households in both counties reported that the solar devices have led to an improvement in these different aspects of life, this was significantly more prevalent in Kilifi than in Garissa (Figure 20). This is reflective of the somewhat different experiences that, on average, households have had with the pilot project across the two counties.

Furthermore, the overwhelming majority of beneficiary households (94%) would recommend the solar device to their family and friends, and this is similar by county, gender of household head, and type of cash transfer.

5.4.2 Education

5.4.2.1 Children's time use

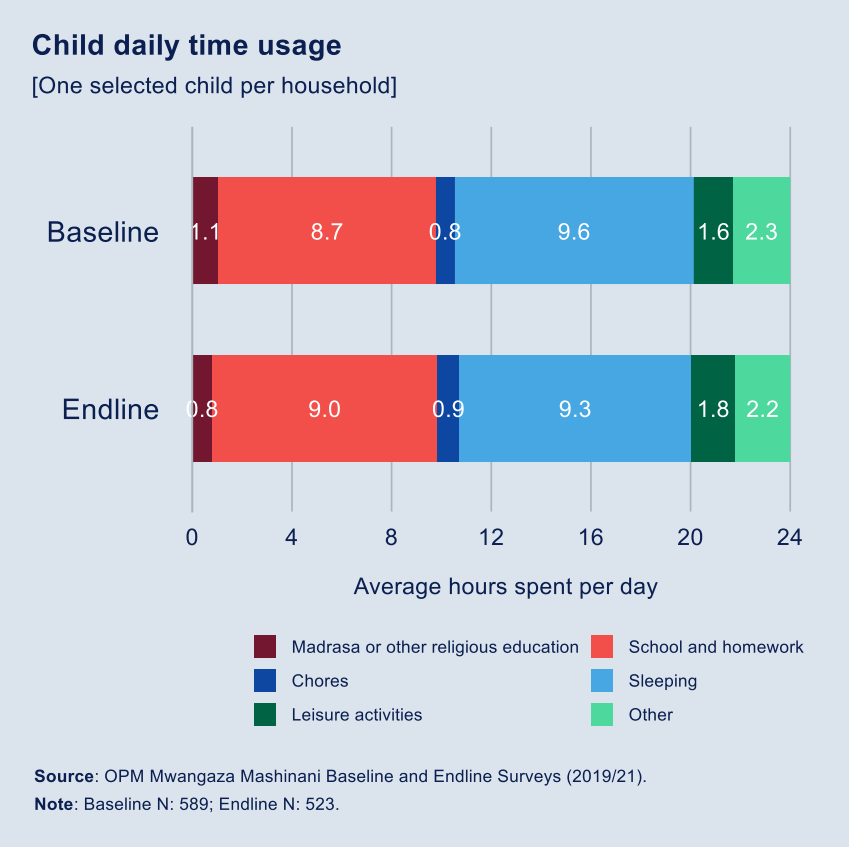
In each household, one child out of all of the children within the household enrolled in primary school was randomly selected for the time use module within the survey. The children's caregivers were asked about how the selected child spends their time on a usual school day (i.e. Monday to Friday). Instead of asking about a typical school day in the current month, as was done at baseline, the reference period used at endline was a typical school day from January to March 2021.[38] There were two reasons for this: first, endline data collection in Kilifi and Garissa was conducted a month apart

[38] While this may have some effect on caregivers' recall of how the child spent their time, we expect this effect to be minimal given that we were asking about a typical day in that period, as opposed to a specific day.

and therefore having a common reference period would ensure comparability of results; and second, schools were on term break when the survey was conducted in Kilifi.

On average, at endline children spend a typical day as follows: nine hours at school and doing homework; 48 minutes attending religious education; 54 minutes on household chores or helping out in the home; one hour and 48 minutes on leisure activities; nine hours and 18 minutes sleeping; and two hours and 12 minutes on other activities (Figure 21). There have been some significant changes in the way children spend their time compared to baseline. Children at endline are spending, on average, more time per day on schooling, leisure activities, and household chores than children at baseline, and they are spending less time attending religious education and sleeping.

Figure 21: Children's time use (over time)



Source: OPM Mwangaza Mashinani Baseline and Endline Surveys (2019/21).
Note: Baseline N: 589; Endline N: 523.

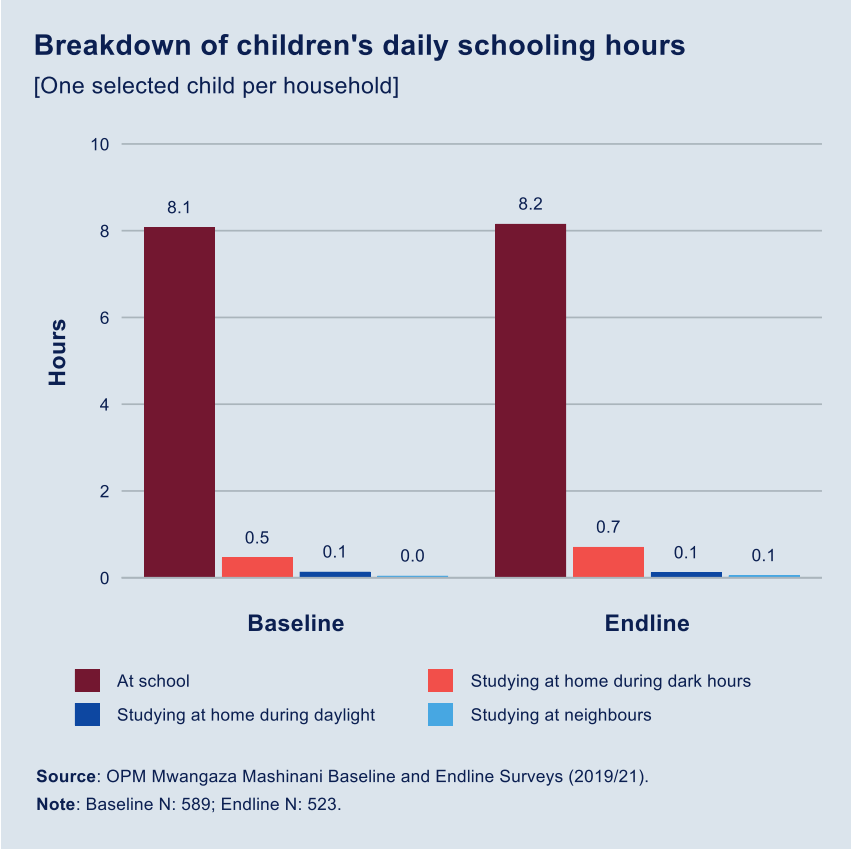
The extra time per day children are spending on leisure activities at endline, which is equivalent to 12 minutes (and represents a 12.5% increase from baseline), is driven by increased leisure time in dark hours, as opposed to in daylight. This is also primarily due to increased time playing at home and resting. On the other hand, the extra time per day children spend on chores at endline compared to baseline (equivalent to six minutes, which represents a 12.5% increase) happens during daylight.

Looking specifically at children's study time at endline (see Figure 22), of the nine hours spent on schooling activities on a typical day, the total time spent in school, including travel time, averages eight hours and 12 minutes.[39] The remaining 54 minutes are spent studying outside the school; specifically: six minutes are spent studying at home in daylight while 42 minutes are spent studying at home in dark hours, and six minutes are spent studying at a neighbour's house. Like at baseline, we find that the majority of time children spend studying outside of school is during dark hours and not daylight. This is because in the daylight hours, aside from attending school, children spend time on religious

[39] This includes all time spent at school, including time in class, time spent studying at school, time spent on extracurricular activities, and time spent traveling to and from school. In Kenya, primary school hours are from 8 am to 3.30 pm and hence children spend 7.5 hours per day at school for classes.

education, household chores, leisure and other activities, such as getting ready for school or preparing and eating meals.

Figure 22: Children's study hours (over time)



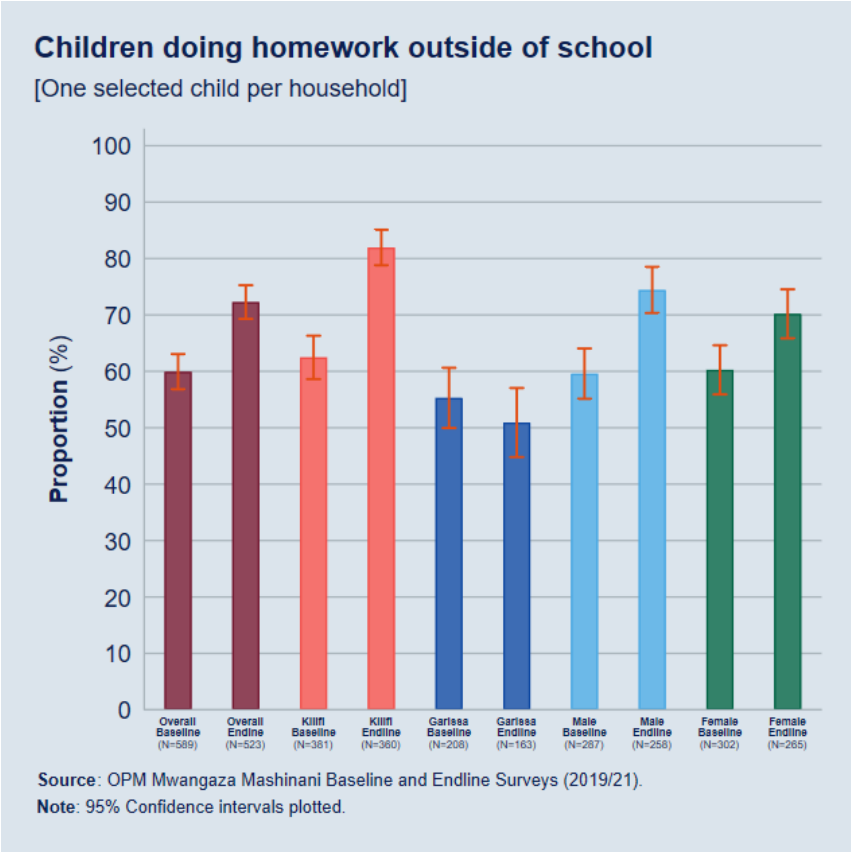
The increase in the amount of time children spend on schooling between baseline and endline is entirely due to increased time studying outside of school, and specifically during dark hours. There has been no significant change in the number of hours children spend in school, including travel time. Rather, the amount of time children are studying outside of school at endline has increased by 14 minutes per day compared to baseline, which is equivalent to a 36% increase. This is entirely driven by increased time doing homework at home during dark hours. This increase is explained by two factors: first, more time is being spent on studying outside of school among the sub-set of children that were doing homework at both baseline and endline; and second, more children are studying outside of school at endline compared to baseline. Specifically, 72% of children at endline are studying outside of school, compared to 60% at baseline (Figure 23).

There are significant differences in how children spend their time in a typical day by county. Compared to children residing in Garissa, children residing in Kilifi spend significantly more time in school, studying outside of school both in daylight and dark hours, on leisure activities, and doing chores. Children in Kilifi spend an extra hour per day in school and an extra 30 minutes studying outside of school, and a higher proportion of children in Kilifi are studying outside of school (82% in Kilifi versus 51% in Garissa). On the other hand, children in Garissa spend more time sleeping and attending religious education. Specifically, children in Garissa spend two hours and 30 minutes per day on religious education, compared to zero hours in Kilifi (even at baseline, children in Kilifi only spent four minutes per day on religious education).

When looking at the pattern of children's time use by gender of the child or household head, we find very few differences. Generally, boys and girls spend their time similarly at endline, with the exception that girls spend more time on chores in a typical day (one hour and six minutes) compared to boys (42 minutes), and less time on religious education (42 minutes for girls versus 54 minutes for boys). This also means that time spent studying outside of school has increased for both girls and boys since

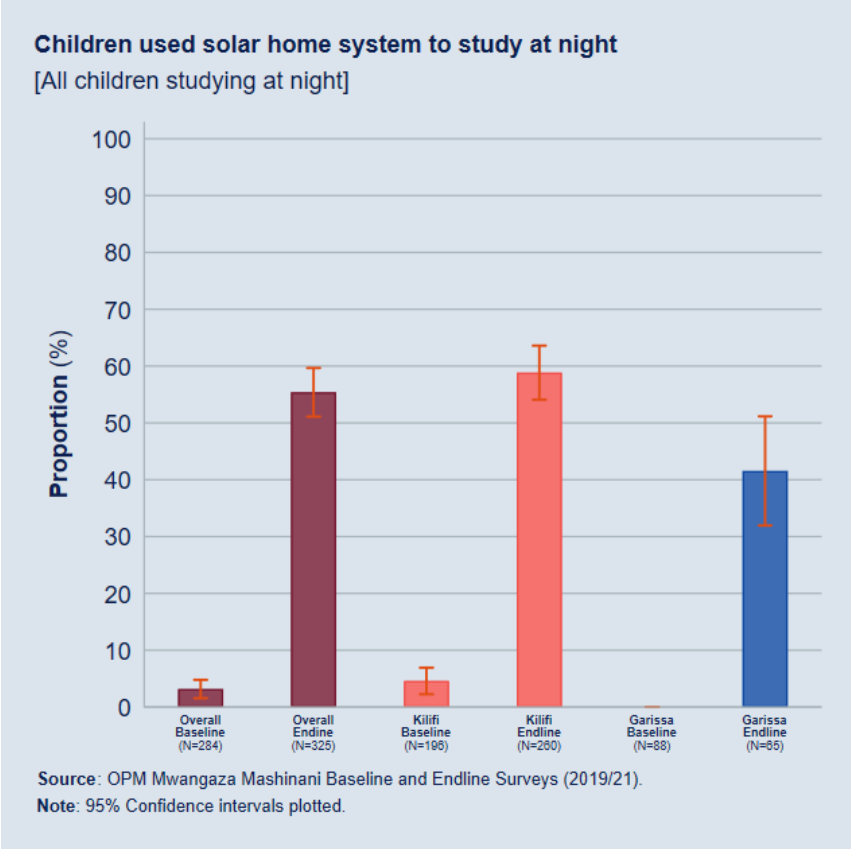
baseline, which is a positive finding. Children in female-headed households (whether boys or girls) spend more time per day on chores than children in male-headed households. At the same time, the proportion of children who study outside of school is higher in female-headed households than in male-headed households (by 8 percentage points). When it comes to differences by cash transfer type, children in OP-CT beneficiary households spend more time per day on chores than children in CT-OVC beneficiary households, while the proportion of children who study outside of school is higher in CT-OVC beneficiary households than OP-CT beneficiary households (by 8 percentage points).

Figure 23: Children studying outside of school (by county and gender, and over time)



As at baseline, the majority of children who study at night at endline (90%) do so using an artificial light source. Among children who study at night, 55% use a solar home system at endline, which is a marked increase of 52 percentage points since baseline (Figure 24). This proportion is higher, at 69%, among children from households that enrolled in the project. On the other hand, significantly fewer children use other sources of lighting, such as kerosene (7% at endline versus 32% at baseline), and dry-cell battery torches (10% at endline versus 42% at baseline). In line with other trends, the use of solar home systems by children for studying at night is more common in Kilifi (59%) than in Garissa (42%). More children in Kilifi also rely on kerosene than in Garissa, while more children in Garissa use dry-cell battery torches. There are no observed differences by gender of child or gender of household head in the sources of light used by children for studying.

Figure 24: Solar home system used by children to study when it is dark (by county and over time)



Impacts attributable to the pilot project

The impact estimation at endline shows that the increase since baseline in the time spent by children on studying outside of school can largely be attributed to the Mwangaza Mashinani pilot project (seeFigure 25 and Figure 26). Among the sample of households intended to be treated, we find a positive impact of the project on the number of minutes children spend per day studying at home in dark hours. The project has increased the time children spend studying at home in dark hours by six minutes per day, which, although modest in magnitude, is significant at the 5% level. We do not find an impact on the number of minutes children spend studying outside of school throughout the day (in both daylight and dark hours).[40] This is shown in Figure 25, where the 95% confidence interval associated with the point estimate for this indicator overlaps with zero.

The impact, however, is stronger among the sub-sample of households that were actually treated. Among the actually treated households, the project increased the number of minutes children spend studying outside school by eight minutes, and the number of minutes children spend studying at home at night by 13 minutes. These estimates are highly significant at the 1% level. The stronger impact observed among the actually treated sample suggests that the project's inability to reach all intended beneficiaries has diluted its potential impact on children's study time.

Figure 25: Impact of the pilot project on children's time use (ITT)

[40] Similarly, we do not find a significant impact on the proportion of children who are studying outside of school.

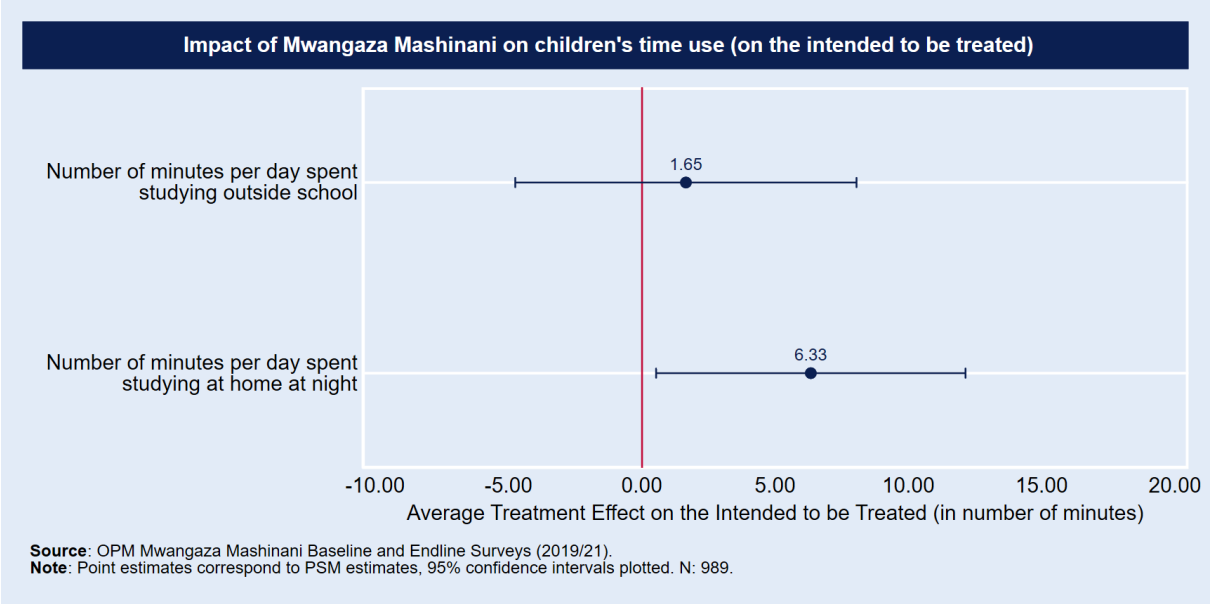
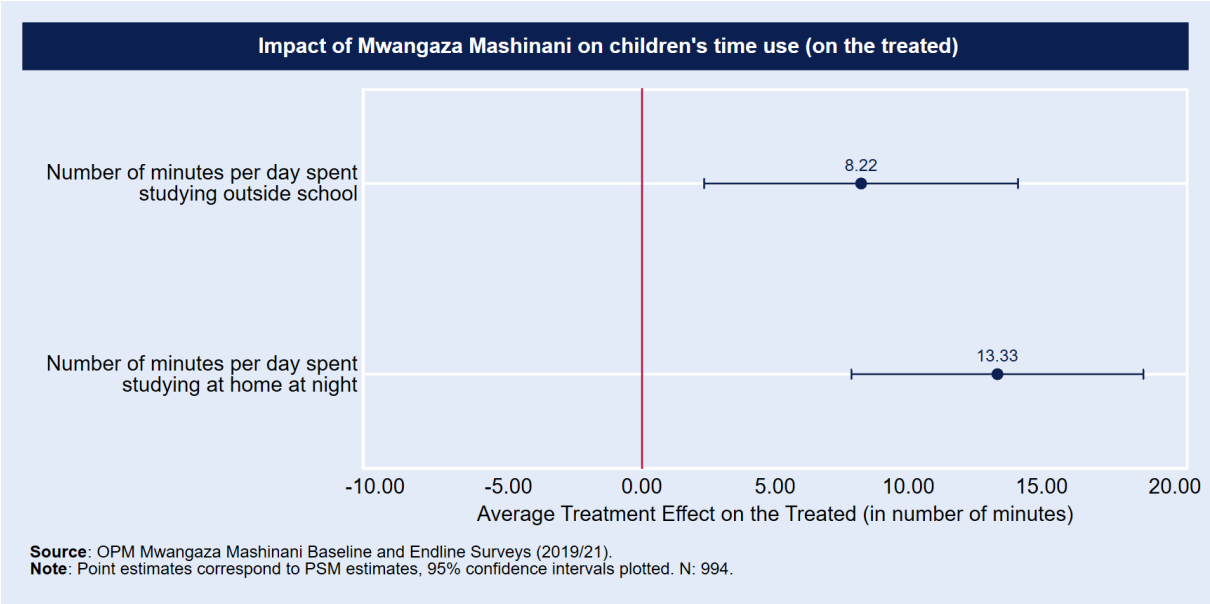


Figure 26: Impact of the pilot project on children's time use (ATT)



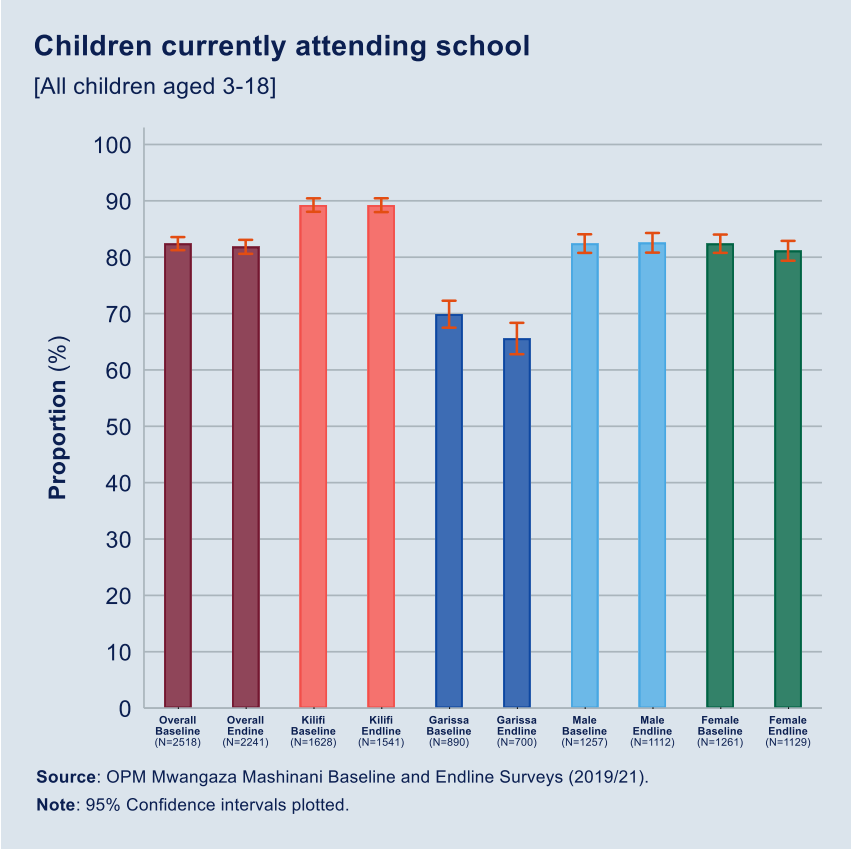
This impact is noticeably large in magnitude when considering that at baseline children were spending an average of 36 minutes per day studying outside of school, and in particular 30 minutes studying at home at night. An additional 13 minutes of study time at night represents a 43% increase from baseline.

5.4.2.2 Educational outcomes

Similarly to the evaluation findings at baseline, children at endline demonstrate high levels of educational outcomes. Specifically, the endline survey finds that 82% of children aged 3–18 years are attending school (Figure 27). Attendance is higher, at 89%, among children aged 6–15 years. These proportions of school attendance are similar to those observed at baseline. While school attendance is still not universal among all school-aged children, in light of the COVID-19 pandemic and the school closures throughout most of 2020 it is a reassuring result that school attendance has not declined

since baseline in the treatment group.[41] Furthermore, all children who are in school at endline are attending in person and not remotely. It is worth noting that while at baseline we asked about current school attendance at the time of the survey, at endline we asked about attendance in the January to March 2021 school term.[42]

Figure 27: Children attending school (by county and gender, and over time)



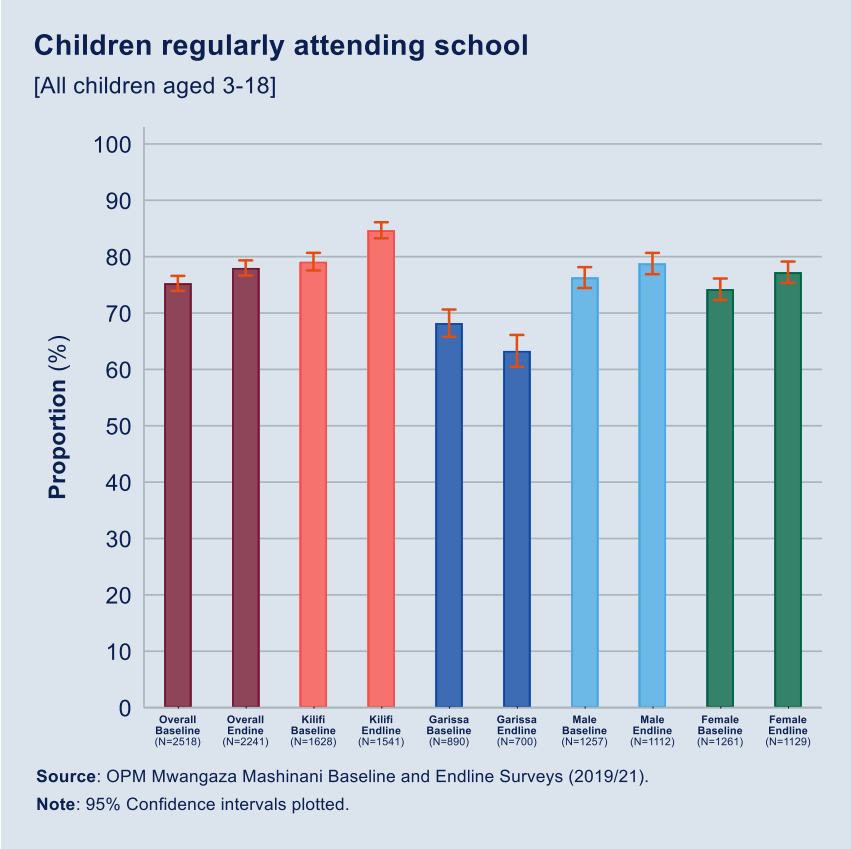
The top three reasons reported for why children of school age were not attending school are: child still too young to attend school (31%), not having enough money for school costs (26%), and child attending madrassa or other religious education instead (15%). No households cited reasons directly related to COVID-19 as having prevented children from attending school.

When factoring in the regularity of school attendance,[43] we find that slightly fewer children are regularly attending school: 78% of children aged 3–18 years and 86% of children aged 6–15 years (Figure 28). These proportions are slightly higher than those at baseline (75% of children aged 3–18 years, and 84% of children aged 6–15 years). At endline, the main reasons cited by households for why children are not regularly attending and have had to temporarily withdraw from school for more

[41] It is worth noting that overall attendance figures in this sample may be higher than found in other surveys due to the specific characteristics of the target population of the Mwangaza Mashinani pilot project, under which having at least one household member enrolled in school is a hard criterion for inclusion.
[42] See Section 4.6 for an explanation of why we used the first quarter of 2021 as the reference period for measuring educational outcomes at endline.
[43] At endline regular attendance was defined as a child who had attended school in January to March 2021 and had not missed more than two consecutive weeks of school days in that quarter. At baseline, a child was classified as regularly attending if they were currently attending school and had not missed more than two consecutive weeks of school days in the last 12 months. It was not possible to apply at endline the exact definition of regular attendance that was used at baseline given that schools in Kenya were closed from March to December 2020 due to the COVID-19 pandemic. The difference in the definition between the two survey rounds might have an effect on the comparability of results as it is possible that children are more likely to miss two weeks of schooling over a period of 12 months than over a period of three months.

than two weeks are lack of funds (56%) and child illness (32%). These are similar to the main reasons reported at baseline.

Figure 28: Children regularly attending school (by county and gender, and over time)

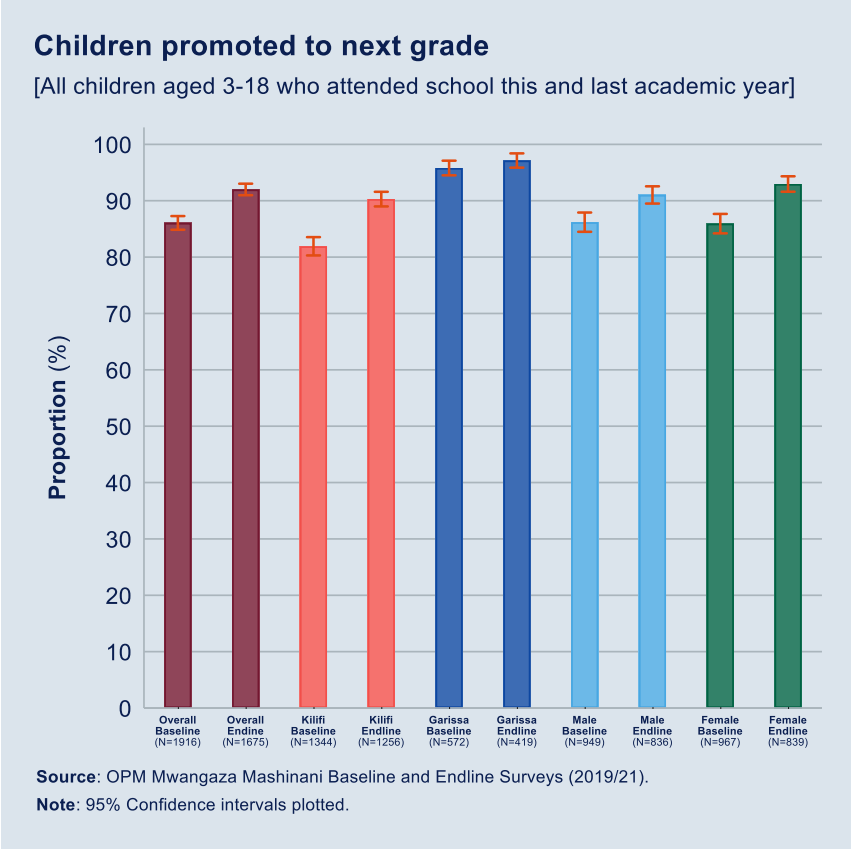


Promotion to subsequent grades is high, at 92% (Figure 29).[44] This is the same for children aged 3–18 years and children aged 6–15 years. This represents a significant increase compared to baseline, where 86% of children aged 3–18 and 89% of children aged 6–15 years had graduated to the next school grade.

While there are no significant differences in school attendance by child gender or cash transfer type, Kilifi has significantly higher attendance rates compared to Garissa. While Kilifi has almost universal attendance among children aged 6–15 years (97%), only three-quarters of children in that age group in Garissa are attending school. A similar gap in attendance exists among children aged 3–18 years between the two counties. Additionally, significantly more children in Kilifi are regularly attending school compared to Garissa (a difference of 21 percentage points for both age groups). There are also differences in the main reasons for children of school age not attending school across the two counties. Lack of funds for school was reported as a main reason significantly more often in Kilifi than in Garissa, while attendance at madrassa was reported as a main reason significantly more often in Garissa than in Kilifi. This is in line with the findings on child time use: children in Garissa spend over two hours a day on religious education, compared to zero hours for children in Kilifi (see Section 5.4.2.1).

Figure 29: Promotion to the next school grade (by county and gender, and over time)

[44] Promotion to subsequent grades at endline was defined as a child who was in a higher academic grade in 2021 compared to their grade in 2019. The reason we do not instead measure grade promotion between 2020 and 2021 is because of the extended school closures in 2020 (due to the COVID-19 pandemic), which led to the 2020 academic year being extended into the first quarter of 2021 (i.e. the school term in January–March 2021 was a continuation of the 2020 academic year and therefore children were in the same grades in 2020 and 2021).



Interestingly, we find that Garissa has a significantly higher proportion of children promoted to the next grade (97%), compared to Kilifi (90%). This was also the case at baseline. Girls and children in CT-OVC beneficiary households are also slightly more likely to be promoted to the next grade, compared to boys and children in OP-CT beneficiary households, respectively.

Impacts attributable to the pilot project

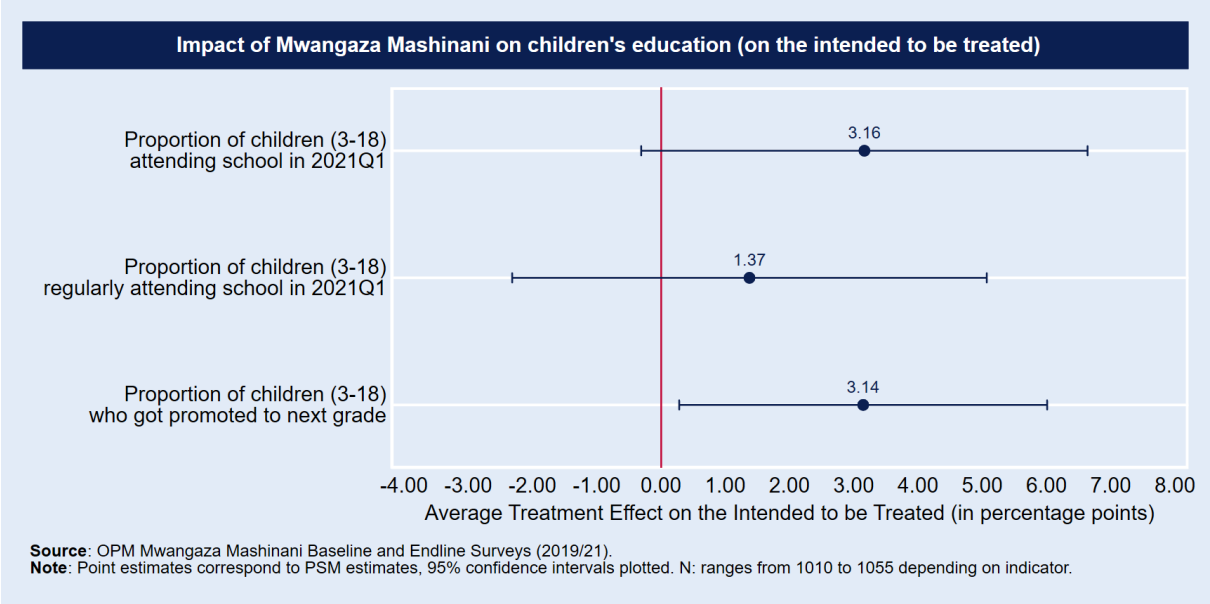
The impact estimation at endline finds a positive impact on children's education outcomes that can be attributed to the Mwangaza Mashinani pilot project (see Figure 30 and Figure 31). We find that among the sample of households intended to be treated, the project has increased the proportion of children aged 3–18 years who are attending school by 3 percentage points, although this is weakly significant at the 10% level. The impact is stronger – an increase of 4 percentage points – and more highly significant at the 1% level, among the sample of households that were actually treated. Given that the school attendance rates among the treatment sample have not changed between baseline and endline, the presence of a positive impact suggests that school attendance would have declined over this time period in the case of the counterfactual, which may be a consequence of the COVID-19 pandemic. The project has therefore played a role in preventing a drop in the attendance rate among children in the beneficiary households.

On the other hand, despite an improvement in the trend of regular attendance among the treatment sample, we find no significant project impact on the proportion of children regularly attending school. This is shown in Figure 30 and Figure 31, as the 95% confidence intervals associated with the point estimates overlap with zero. This suggests that the increase we observe in the treatment sample over time would have occurred in the case of the counterfactual.

We also find a positive impact on grade promotion. Among the sample of households intended to be treated, the project has increased the proportion of children aged 3–18 years who were promoted to the next academic grade by 3 percentage points, and this is significant at the 5% level. Among the actually treated sample, the project has increased the proportion of children aged 3–18 years who were promoted to the next grade by 2 percentage points, but this is weakly significant at the 10% level. It is worth noting that the impact we observe on grade promotion at endline is in fact the short-

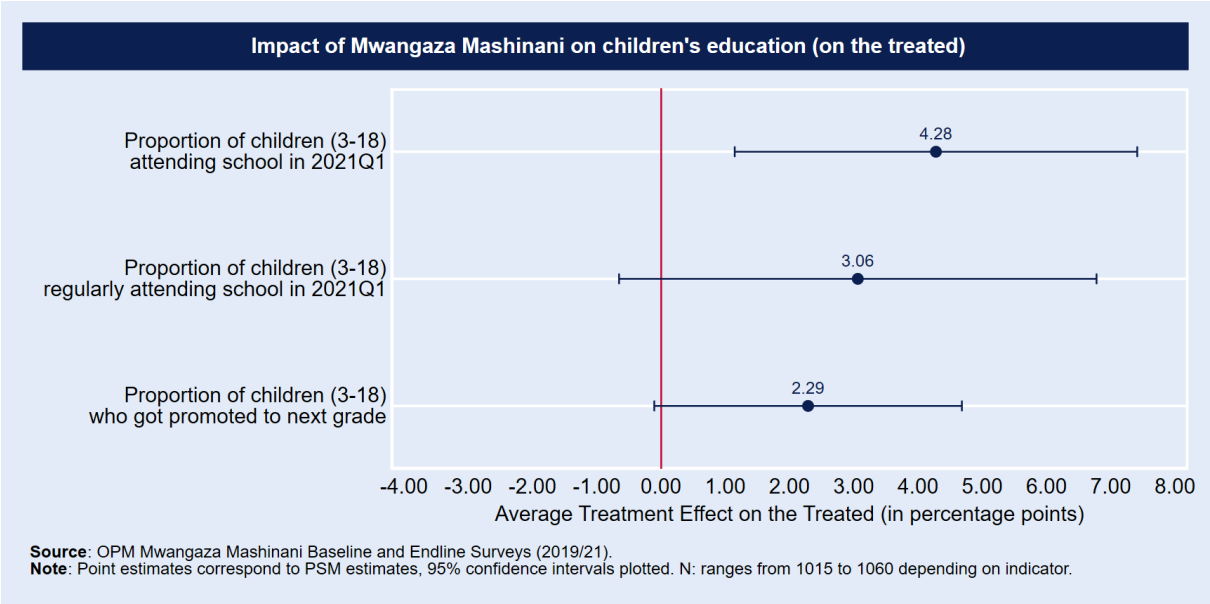
term impact of the project that would have materialised between baseline and January 2020. This is because, as mentioned earlier, the school term from January to March 2021 was a continuation of the 2020 academic year, and therefore children attended the same grades at the start of 2020, when schools were still open, and in the first quarter of 2021.

Figure 30: Impact of the pilot project on children's education (ITT)



Source: OPM Mwangaza Mashinani Baseline and Endline Surveys (2019/21).
Note: Point estimates correspond to PSM estimates, 95% confidence intervals plotted. N: ranges from 1010 to 1055 depending on indicator.

Figure 31: Impact of the pilot project on children's education (ATT)



Source: OPM Mwangaza Mashinani Baseline and Endline Surveys (2019/21).
Note: Point estimates correspond to PSM estimates, 95% confidence intervals plotted. N: ranges from 1015 to 1060 depending on indicator.

These findings represent important impacts on children's educational outcomes. In Box 8 we situate the magnitude of the impact we observe on school attendance as a result of the pilot project within the context of other development interventions that aim to increase school attendance. Possible explanations for these positive effects could include the cost savings on energy and the increased study hours resulting from the project. It is possible that the monthly savings on lighting and the costs of charging mobile phones afforded by the project are providing available funds for households to send their children to school. The qualitative research at midline found that the money households were saving from not buying kerosene or batteries, and from being able to charge their own phones, supplemented spending on food and school supplies. Furthermore, at midline we found that among the 28% of beneficiary households that reported earning additional income from the project solar

device, 18% reported spending it on school fees and materials (which was the second most common use of the additional income after spending on food). Furthermore, it is also possible that the impact the project is having on children's increased time studying at home is incentivising more households to send their children to school. However, further investigations through additional qualitative research would be required to understand the mechanisms through which the project has had an impact on child school attendance and promotion to subsequent grades.

Box 8: Comparison of impact on school attendance from pilot project to other education interventions

The International Initiative for Impact Evaluation (3ie) conducted a systematic review in 2015 which synthesised evidence on the effects of education interventions in low- and middle-income countries on children's access to education and learning outcomes (Snilstveit *et al*., 2015). The review looked at the effects of over 200 programmes from across 52 countries, spanning a wide range of interventions at the levels of the child, household, school, teacher, and system. Effect sizes from the evaluations of these different programmes were extracted and standardised in order to be able to compare the magnitude of impact on education outcomes across the different interventions. Standardised mean differences (SMDs) were thus calculated for the different studies.

To benchmark the effect size on school attendance from the Mwangaza Mashinani pilot project we calculate an equivalent SMD of the impact estimate among the actually treated sample using the formulae provided in the systematic review report (Snilstveit *et al*., 2015, p. 25). We find that the pilot project has had an effect of 0.08 SMD on school attendance. This is comparable to some of the interventions highlighted by the systematic review as having a promising effect on school participation outcomes, and specifically school attendance. The systematic review found that cash transfer programmes have the largest average effects on school attendance, equivalent to 0.13 SMD. School feeding programmes and the construction of new schools were found to have promising effects on school attendance, equivalent to 0.09 SMD and 0.08 SMD, respectively. The majority of other types of interventions reviewed were found to have smaller effect sizes. For instance, school-based health programmes such as deworming, were found to have average effects on school attendance of 0.04 SMD.

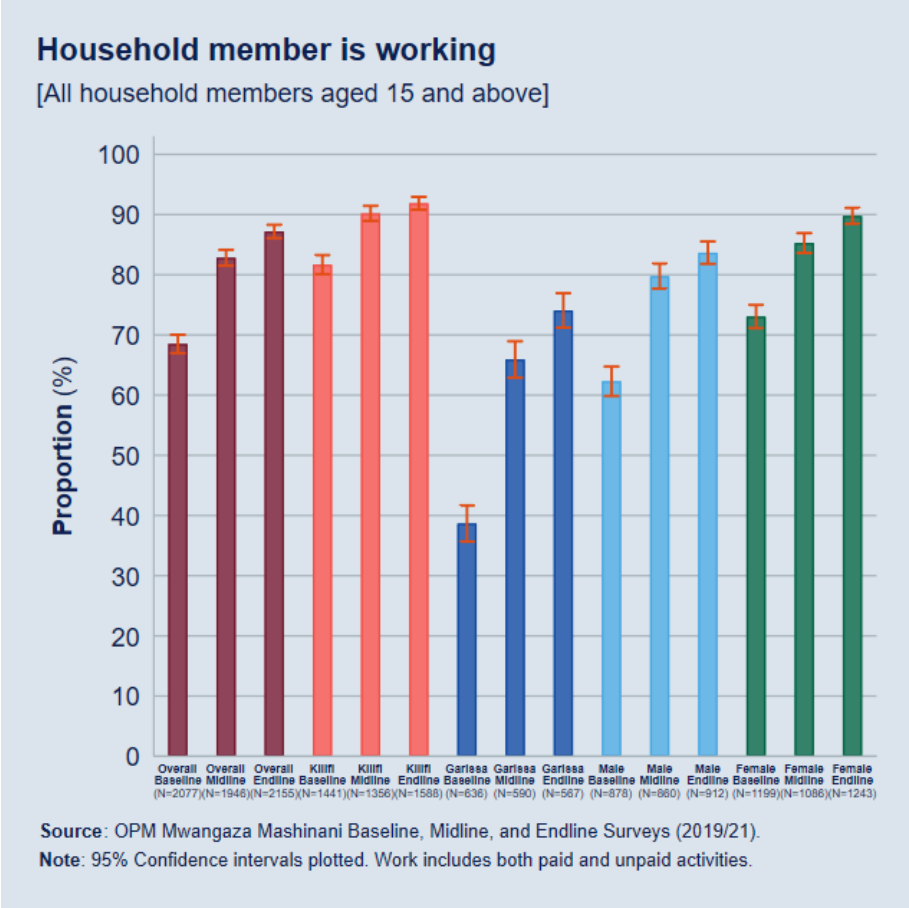
5.4.3 Livelihoods

5.4.3.1 Number and type of livelihood opportunities

At endline, more household members in the treatment sample are engaged in productive activities than were at baseline and midline. The proportion of household members aged 15 and above that are engaged in work has significantly increased over time, from 69% at baseline to 83% at midline, and then further to 87% at endline ((Figure 32Figure 32). This includes both paid and unpaid work, either inside or outside the household.[45]

Figure 32: Household member is working (by county and gender, and over time)

[45] This definition for livelihoods was agreed with UNICEF at baseline. The livelihoods module used in the baseline, midline, and endline surveys relied on survey modules from the OPM evaluation of the Hunger Safety Net Programme and Kenya Integrated Household Budget Survey.



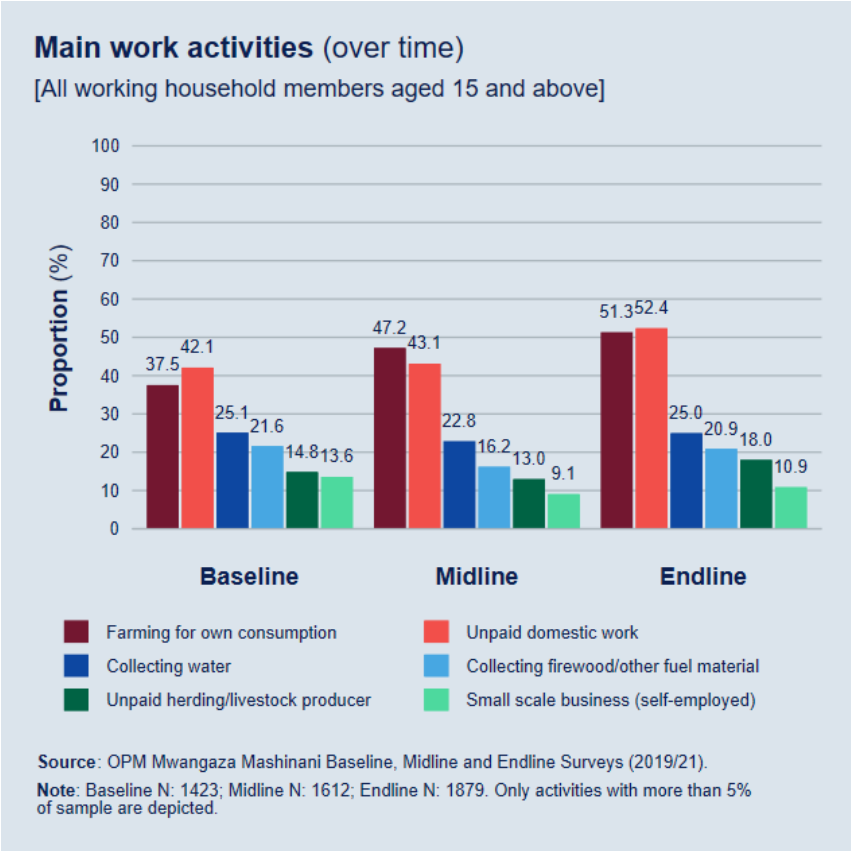
The main reasons cited for not working among household members aged 15 and above include being too old to work (43%), being unable to work (27%), attending school (19%), and being unemployed (10%). Only 1% of household members not working reported COVID-19 as the reason. These are similar to the proportions found at midline. However, compared to baseline, significantly more household members are not working at endline because of old age and inability to work, while fewer household members are not working because they are unemployed or still in education.

The main types of productive activities household members are engaged in are unpaid domestic work and unpaid subsistence agricultural work (Figure 33). The top six activities among working household members in the treatment sample are unpaid domestic work (52%), farming for own consumption (51%), collecting water (25%), collecting firewood or other fuel materials (21%),[46] unpaid herding or livestock production (18%), and being self-employed in a small-scale business (11%). While the two main types of activities household members engage in are the same across all three survey rounds, there have been some significant changes over time. Compared to baseline, significantly more household members at endline are engaging in unpaid activities, such as domestic work, farming for own consumption, and unpaid herding or livestock production; on the other hand, significantly fewer household members at endline are engaging in paid activities that include small-scale business, woodworking trade, paid domestic work, paid agricultural or fishing work, teaching, etc. At midline, we found that household members had increased their engagement in farming for own consumption since baseline, while for all other work activities either there was a decrease over time or no change. At the time we speculated that this could have been driven by seasonality effects or COVID-19 lockdown measures, which would have limited household members' engagement in productive activities outside the household. However, it seems that household members have further reduced their engagement in paid activities between midline and endline, and increased their engagement in unpaid activities, even following the relaxation of most COVID-19 lockdown measures. One factor that may explain this is

[46] Activities such as collecting water and collecting firewood are often simultaneously paid and unpaid as household members collect water or firewood both for their own household and for other households for a fee.

seasonality effects, given that the midline and endline surveys were not conducted in similar months of the calendar year.[47]

Figure 33: Main work activities (over time)



For those household members who are engaged in paid or unpaid work at endline, on average, each household member is engaged in 1.9 activities. This is very slightly higher than the 1.8 activities at baseline, and 1.7 activities at midline, although the differences are statistically significant.

At the household level, the number of household members aged 15 and above that are engaged in productive activities has significantly increased since baseline, from an average of 2.4 to 3.3 at endline (no changes between midline and endline). This has also led to an increase in the average number of activities that households are engaged in, from 4.7 at baseline and 5.5 at midline to 6.5 at endline. Furthermore, while there was an increase between baseline and midline in the proportion of new activities that households started in the year prior to the survey, this proportion decreased between midline and endline such that at endline a third of household activities were newly started in the year prior to the survey – which is the same as the proportion at baseline. The temporary increase at midline may have been a result of the COVID-19 pandemic, which necessitated changes in the work household members engage in.

Across counties, we find stark differences in the number and types of productive activities that households engage in. While 92% of household members in Kilifi are engaged in work, only 74% of household members in Garissa are, although this gap has decreased since both baseline and midline (Figure 32). The average household in Kilifi is also engaged in more than double the number of activities (8.1) that an average household in Garissa is engaged in (3.3). There are also significant differences in the types of activities households engage in across counties. Across all three survey rounds, while the majority of household members in Kilifi work in farming for own consumption, almost

[47] The endline survey was conducted from April to June 2021 (with a break between Kilifi and Garissa), while the midline survey was conducted in August 2020 and the baseline survey was conducted from February to April 2019.

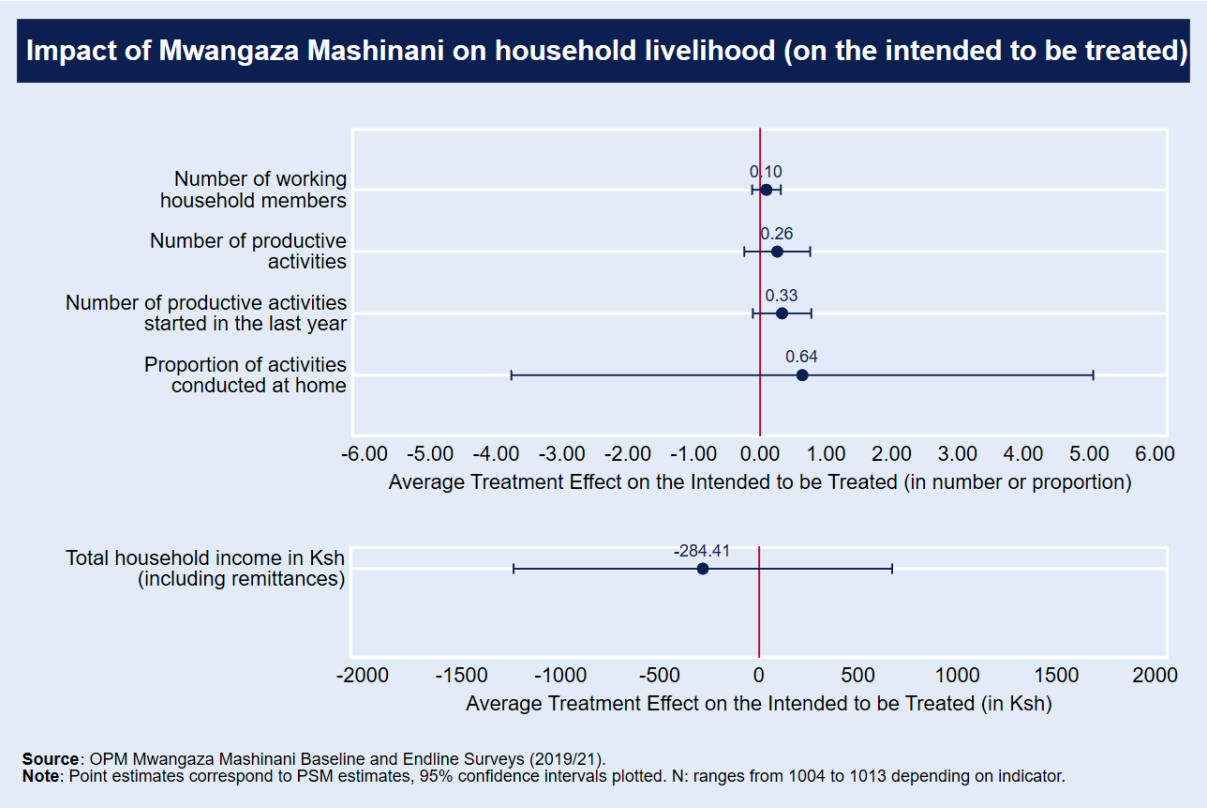
none of the household members in Garissa do. Collecting water, firewood, and other fuel materials is also more common in Kilifi. On the other hand, more household members in Garissa are engaged in unpaid domestic work, unpaid herding and livestock production, and small-scale business.

We also find significant differences between men and women, with more women engaged in work (90%) than men (84%), as shown in Figure 32. Women, on average, are also engaged in a higher number of activities. While women are most commonly engaged in unpaid domestic work (76%), farming for own consumption (54%), collecting water (34%), and collecting firewood and other fuel material (29%), men are engaged in farming for own consumption (48%), unpaid herding or livestock production (31%), unpaid domestic work (19%), and manual labour (9%).

Impacts attributable to the pilot project

Despite the improvement in trends over time in regard to the number of working household members and the number of productive activities per household, there is no evidence that these can be attributed to the Mwangaza Mashinani pilot project. Results from the impact analysis do not show a significant impact on either indicator, for either the intended to be treated and actually treated samples. This is shown in Figure 34 below and Figure 43 in Volume II, where the 95% confidence intervals associated with the point estimates overlap with zero. This suggests that the increase in the number of working household members and productive activities that we observe in the treatment group over time would have occurred in the case of the counterfactual. While it is not possible to identify the causes from the available evidence, possible factors that may explain this trend over time include seasonality effects, the effects of COVID-19 on households' livelihoods, or the fact that schools were closed in Kilifi at the time of the endline survey (while schools were in term during the baseline survey).

Figure 34: Impact of the pilot project on household livelihoods (ITT)



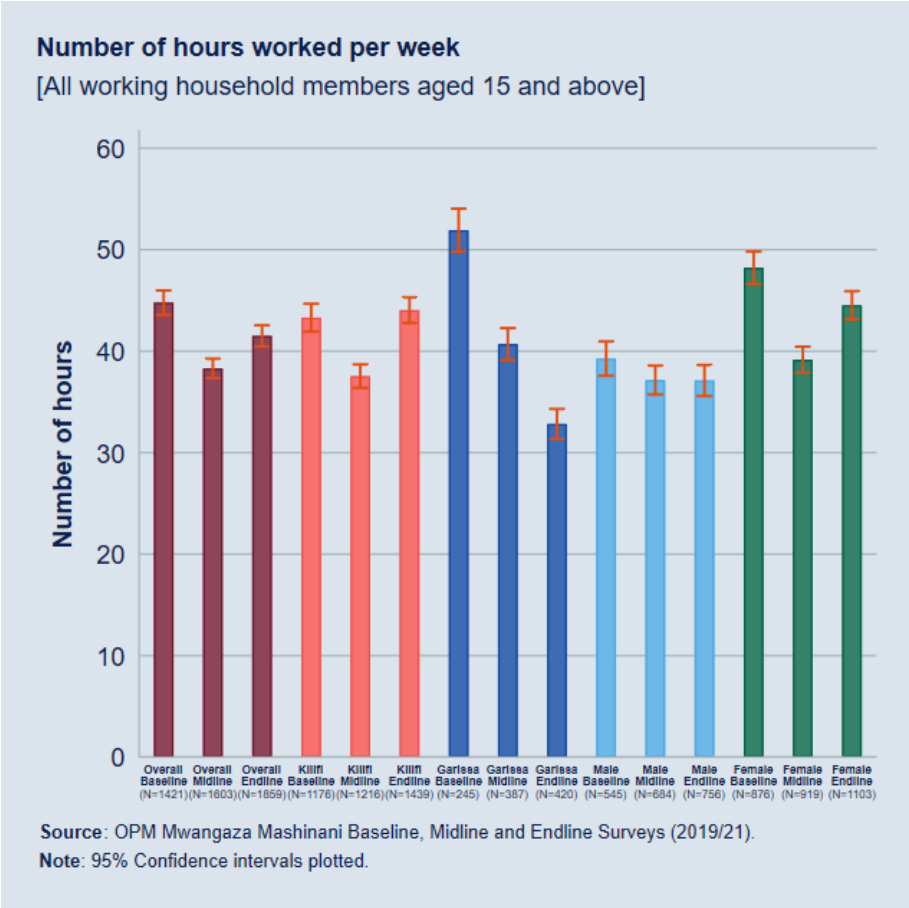
Source: OPM Mwangaza Mashinani Baseline and Endline Surveys (2019/21).
Note: Point estimates correspond to PSM estimates, 95% confidence intervals plotted. N: ranges from 1004 to 1013 depending on indicator.

At midline, the evaluation found a positive but modest impact of the pilot project on the number of working household members (among both the intended to be treated and actually treated samples) and the number of productive activities per household (among the actually treated sample only). It therefore seems that this mid-term impact had not been sustained by the time of the endline survey.

5.4.3.2 Working hours

Working household members spend on average 42 hours working per week, which is an increase from the number of working hours at midline (38) but a decrease from the average working hours at baseline (45) (Figure 35). At baseline, working household members in Garissa worked on average nine more hours per week than working household members in Kilifi. However, working hours have decreased markedly in Garissa since midline, such that by endline household members in Kilifi are working 11 more hours per week compared to those in Garissa. We also find significant differences in the average weekly working hours by gender, whereby women work an additional seven hours per week compared to men.

Figure 35: Number of hours worked per week (by county and gender, and over time)

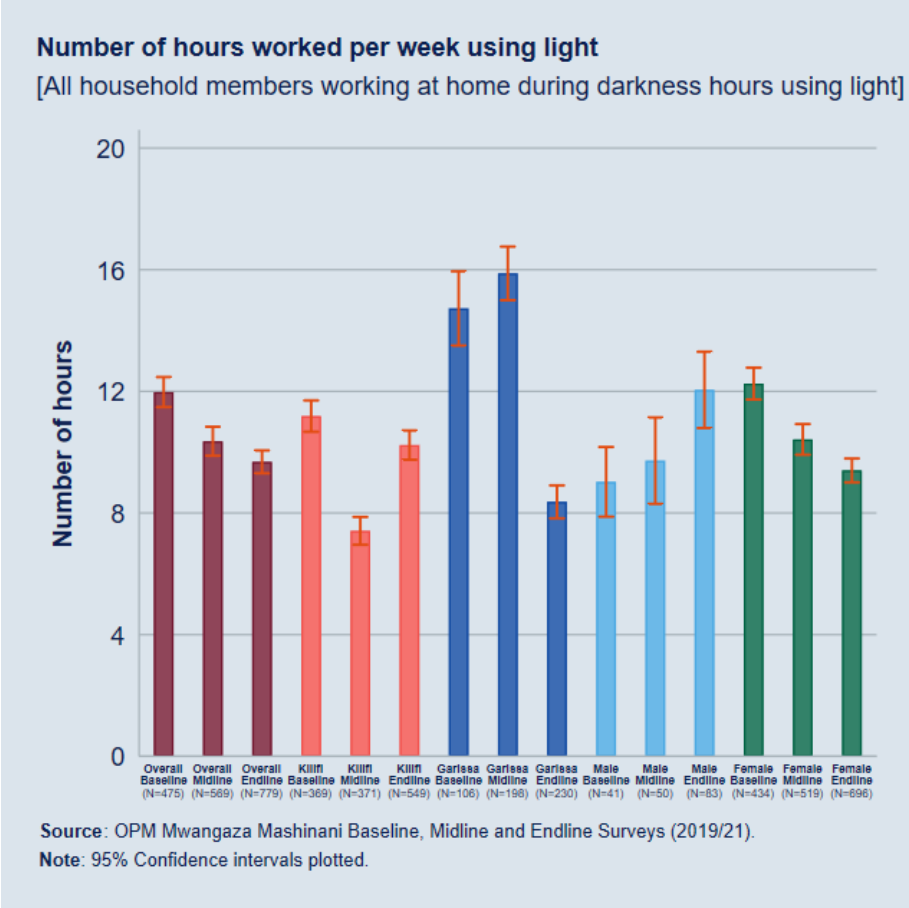


At endline, half of all productive activities households engage in are conducted inside the home. This is a significant increase from the mean proportion of activities conducted at home (41%) at baseline. Despite this change in the treatment sample over time, we find no attributable impact of the pilot project on the mean proportion of household activities that are conducted at home, for either the intended to be treated or actually treated sample. This is shown in Figure 34 above and Figure 43 in Volume II, where the 95% confidence intervals associated with the point estimates overlap with zero.

Of all working household members at endline, 42% conduct some of their work at home during dark hours and using artificial light. While this proportion of working household members who work at home using artificial light has increased since both baseline (by 8 percentage points) and midline (by 5 percentage points), the number of weekly working hours using light during dark hours has decreased from 12 hours at baseline to 10 hours at endline (Figure 36). Analysis across counties reveals that more working household members in Garissa work at home using artificial light (by 17 percentage points), but they spend on average two fewer hours per week working using light, when compared to household members in Kilifi. In line with the trend regarding total weekly working hours, working hours

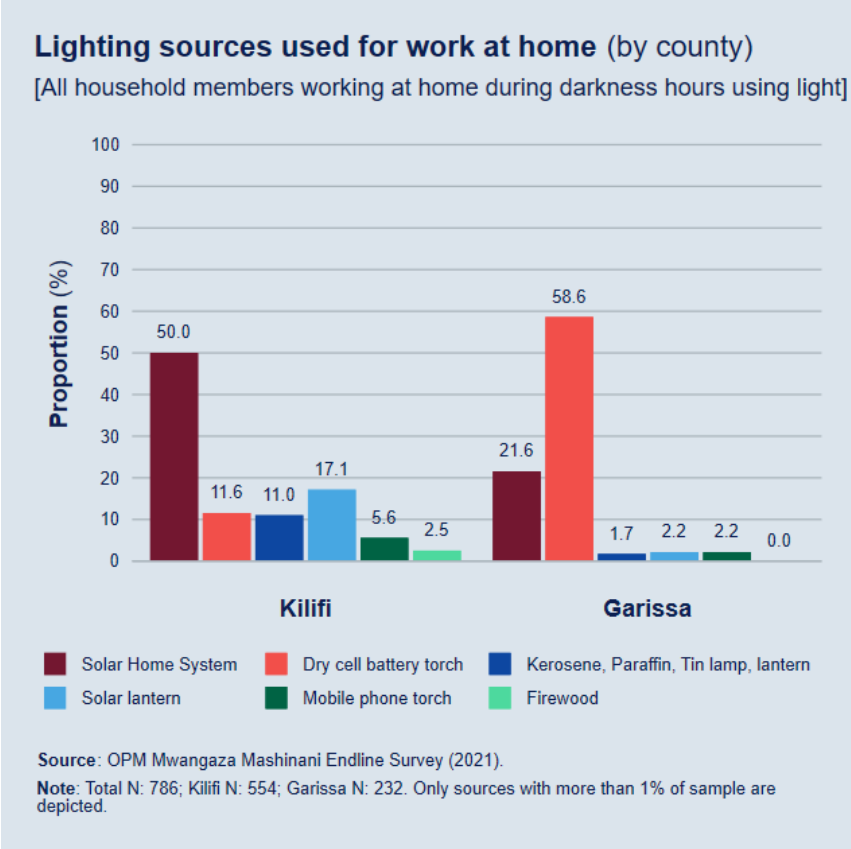
per week using light have decreased markedly since midline (cut by half). Furthermore, within households, it is mainly women who are using artificial light to conduct activities at home during dark hours: while 63% of working women conduct activities at home using light, only 11% of working men do so.

Figure 36: Number of hours worked per week using light (by county and gender, and over time)



The main type of artificial light used by household members to conduct their activities at home during dark hours is a solar home system (42%), followed by dry-cell battery torch (25%), solar lantern (13%), and kerosene (8%). As expected, the proportion of household members using solar home systems as the primary source of lighting for work is higher (at 53%) when looking at the sample of households who actually enrolled in the project. Similarly to the findings on the general use of lighting sources presented in Section 5.4.1.1, we find that among household members who work during dark hours, use of solar home systems is considerably more prevalent in Kilifi (50%) than in Garissa (22%) (Figure 37). On the other hand, household members in Garissa are relying primarily on dry-cell battery torches for working during dark hours. As for analysis by gender, the only difference we observe is that more women use solar lanterns for working at home than men.

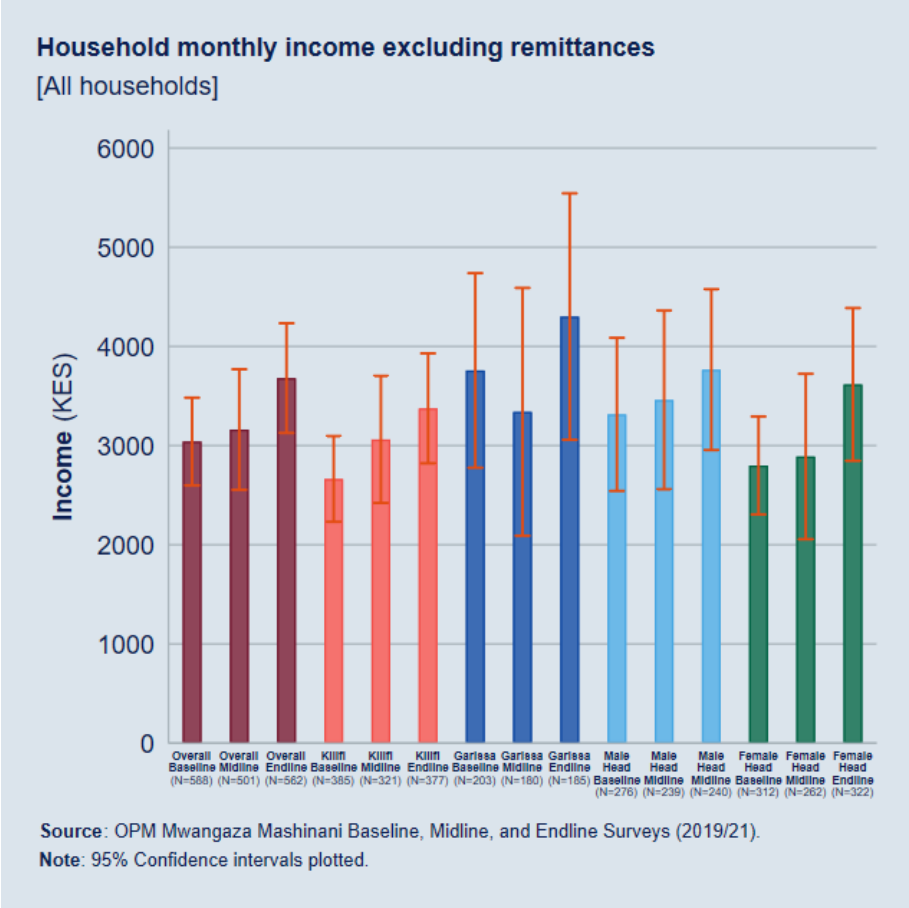
Figure 37: Lighting sources used for work at home during darkness hours (by county)



5.4.3.3 Income and savings

Households were asked how much income they earned in the month prior to the survey from each activity they engage in. At endline, household income from all activities (but excluding income from remittances) in the month prior to the survey is on average KSH 3,680. This represents an increase from the baseline average monthly income of KSH 3,041, though the difference is weakly significant (Figure 38). Income from productive activities has not significantly changed since midline.

Figure 38: Household monthly income excluding remittances (by county and gender of household head, and over time)



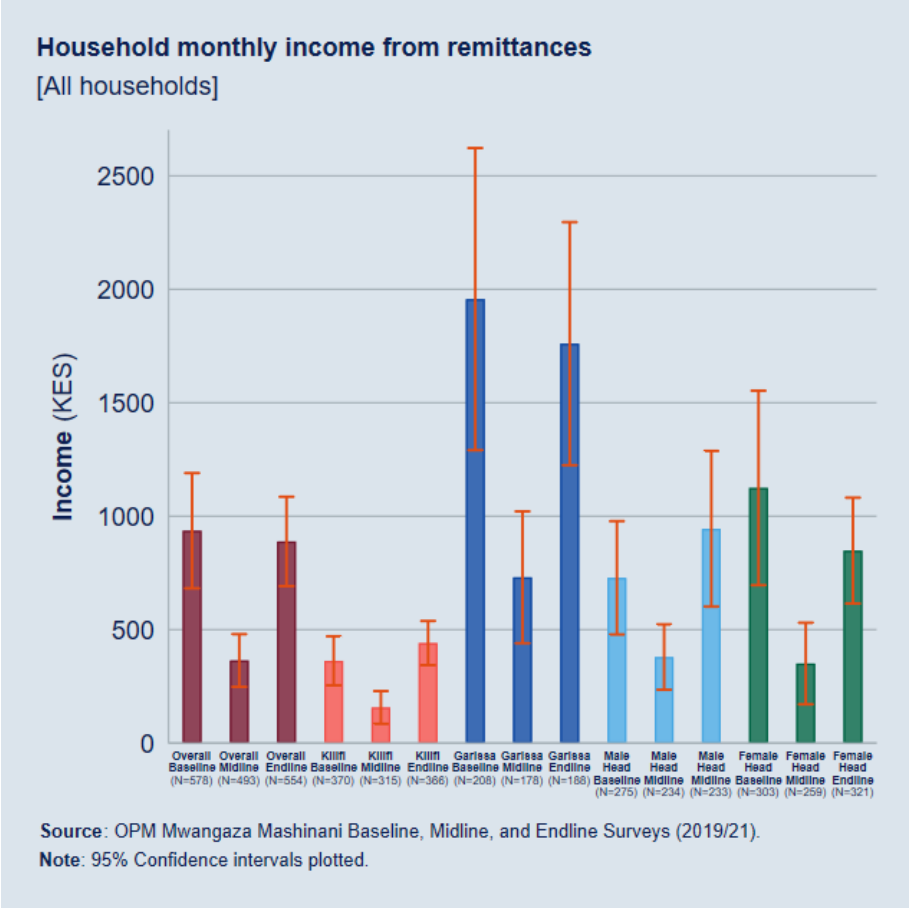
Households were also asked about income from remittances, as a large proportion of treatment households receive remittances (almost one-third at baseline) and these are an important source of household income (accounting for around a quarter of overall household income at baseline, and over 40% in Garissa). Between baseline and midline, income from remittances decreased considerably: this is most likely a consequence of the COVID-19 pandemic. However, remittances almost fully rebounded between midline and endline, such that by endline the average monthly amount households receive in remittances (KSH 889) is similar to the amount at baseline (Figure 39).

Combining both income from productive activities and income from remittances, we find that total household income in the month prior to the survey was on average KSH 4,551. While there are no significant changes in total household income between baseline and endline, total income at endline is significantly greater than income at midline by KSH 1,030 (driven by the differences in remittances).

When it comes to differences in household income across counties, while there are no differences in the monthly household income from productive activities, the monthly income from remittances in Garissa is almost four timed greater than that in Kilifi. As a result, while households in Garissa receive on average a total monthly income of KSH 6,072, households in Kilifi receive an average of KSH 3,804. As for differences in monthly income by gender of the household head, we see none at endline.

Finally, we find that at endline a minority of household members aged 15 and above (16%) are part of a savings scheme, though this increased by 5 percentage points since baseline and 3 percentage points since midline. There is a significant difference between counties, with 17% of household members aged 15 and above belonging to a savings scheme in Kilifi, compared to 12% of members in Garissa. This gap has narrowed since midline. Results also differ by gender, with significantly more women belonging to a savings scheme than men (24%, compared to 5%).

Figure 39: Household monthly income from remittances (by county and gender of household head, and over time)



Impacts attributable to the pilot project

The impact analysis conducted at endline finds no evidence of a significant impact of the pilot project on household monthly income among the sample of households intended to be treated. However, the analysis shows a negative impact of KSH 872 on total household monthly income among the actually treated sample (Figure 43 in Volume II). However, this impact is weakly significant, at the 10% level. It is not clear what could explain this result but it is worth noting that the reported income should be interpreted cautiously as it is difficult to collect reliable self-reported income data, and data of this kind are usually considered unreliable in the literature.

The lack of an impact of the Mwangaza Mashinani pilot project on household livelihoods is not surprising given that at baseline limited impact was expected in this area, mainly because of the low power output of the project-provided solar home systems. In line with this evidence, at endline, only 5% of households reported that earning more money is a benefit of the solar device. Furthermore, only a minority of households reported actually earning additional income from using the solar home system provided by the project, primarily through charging other households' mobile phones for a fee. However, this activity has limited scope for providing material earnings for households, particularly once there is saturation of the market for charging mobile phones. During the midline qualitative interviews, the perspective on this from some of the CCs and BWCs was that income generation from mobile phone charging is only feasible when there are few solar devices in the community. Once the majority of a community owns a solar device with the capacity to charge phones, there is little opportunity to make money from this service. Signs of the saturation of the market can already be seen at endline: the average cost per mobile phone charge has decreased significantly since baseline (Section 5.4.1.1). Also, significantly fewer households at endline (24%) are using the solar device to charge other households' mobile phones compared to midline (42%), and not all of those are charging a fee for it. Only about 15% of beneficiary households are using the device to charge other households' phones for a fee. The qualitative research also suggests that, in most cases, it is a woman who collects the fee for charging a phone; this is corroborated by the endline survey, which

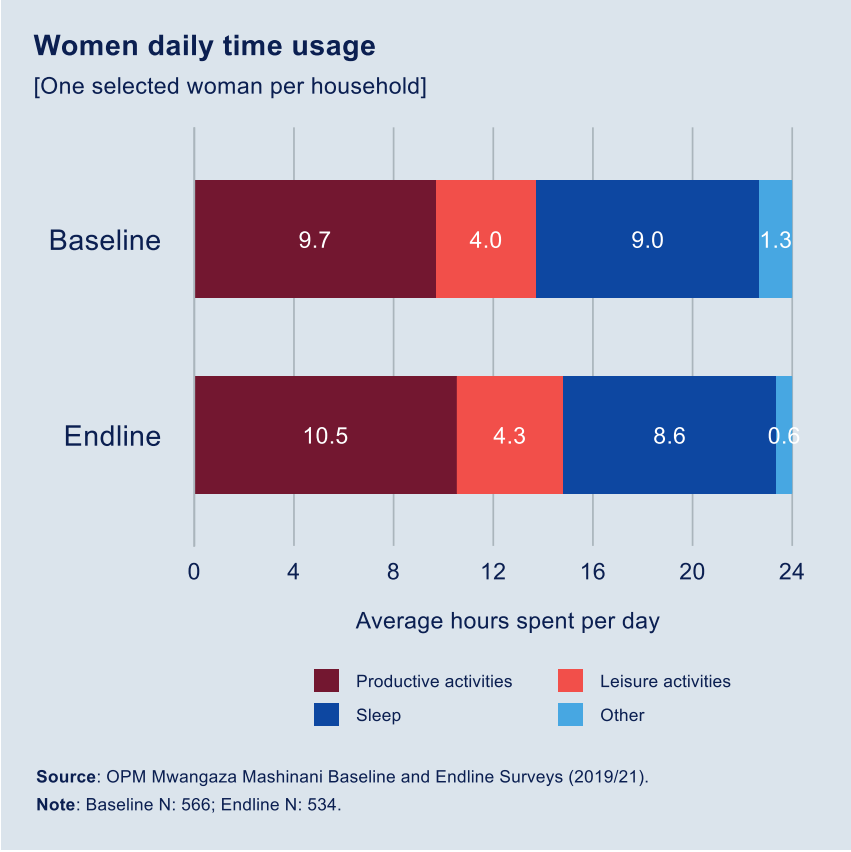
found that this practice is much more prevalent in female-headed households than male-headed households. The reason provided by men for not collecting or using this money is that it is considered 'small change', and it would be unnecessary or shameful to collect such a small sum for themselves. This suggests that households have few expectations regarding the solar home system having a material effect on their livelihoods.

5.4.3.4 Women's time use and time poverty

In each household, one female member was selected to answer the time use module.[48] The purpose of conducting a detailed time use module was to understand how women spend their time in a typical week-day, and what the potential impact of increased light hours might be on women's time use.

As shown in Figure 40, on average women spend 10 hours and 30 minutes on a typical week-day engaging in productive activities,[49] four hours and 18 minutes on leisure activities, eight hours and 36 minutes sleeping, and 36 minutes on other activities.[50] The majority of the time spent by women on productive activities is spent on unpaid labour, at an average of nine hours and six minutes each day. In comparison, women are found to spend only one hour and 30 minutes on paid labour per day.

Figure 40: Women's time use (over time)



Source: OPM Mwangaza Mashinani Baseline and Endline Surveys (2019/21).
Note: Baseline N: 566; Endline N: 534.

Compared to baseline, women are spending significantly more time on productive activities (an extra 48 minutes) at endline, but significantly less time sleeping and on other activities. The increase in time spent on productive activities is driven completely by increased hours on unpaid labour, in particular

[48] The order of selection was as follows: the household head if they were a female, if not available then one of the female spouses, and if not available then a random female household member aged 15–59 years.
[49] This includes time spent preparing or eating meals, collecting firewood, going to the farm, working on the plot (unpaid), taking care of and feeding animals, cutting grass for fodder (unpaid), and time spent at work or on other activities, such as needle work, knitting, weaving, making baskets, carving soap stones, tailoring, and repairing clothes.
[50] Other activities includes activities like getting ready, buying household goods (including travel time), and travel to and from work.

more time spent going to the farm or working on the plot for no pay, which is an activity that does not require the use of an artificial source of lighting.

On average, women are spending two hours and 42 minutes per day carrying out productive activities at home in dark hours. This has significantly increased since baseline, when the average was two hours and 24 minutes. The use of solar energy for productive and social purposes has, as expected, increased markedly since baseline. About half of women surveyed for the time use module reported using a solar lighting source for carrying out productive activities during dark hours, and similarly half reported using solar lighting for social activities. This is even higher, at 60%, among women in households that enrolled in the project.

There are some significant changes in women's time use across counties. Women in Kilifi spend more time per day on work-related activities (11 hours and 12 minutes), compared to women in Garissa (nine hours and 12 minutes), and this is driven primarily by increased hours on unpaid labour among women in Kilifi. On the other hand, women in Garissa spend more time on paid labour (two hours and 18 minutes), compared to women in Kilifi (one hour). Women in Garissa also spend significantly more time in a typical day on leisure activities (five hours and 42 minutes) than women in Kilifi (three hours and 36 minutes). Time spent on productive activities during dark hours and the use of solar lighting for productive and social purposes are also more common in Kilifi than in Garissa. Specifically, while over 60% of women in Kilifi use solar lighting for productive activities, and similarly over 60% use it for social activities, less than a quarter of women in Garissa use it for these purposes.

At baseline and endline, we also measured women's time poverty. Bardasi and Wodon (2006) define time poverty as a situation where 'some individuals do not have enough time for rest and leisure after taking into account the time spent working, whether in the labour market, for domestic work, or for other activities such as fetching water and wood'. There is a risk that increasing the number of light hours by introducing solar energy could contribute to increased time poverty, particularly among women, who are usually responsible for domestic work and other activities, such as fetching water and wood. Box 9 describes the approach to measuring time poverty that was used at baseline and endline.

Box 9: Measuring women's time poverty

The first step in determining time poverty is to set a threshold. Following Chatzitheochari and Arber (2012), the poverty line is set at 60% of the median of the distribution of free (leisure) time. Free time is defined as the residual category of daily time that is not occupied by work (paid or unpaid) or personal care activities. Paid work refers to the time spent in the workplace and job-related activities like commuting. Unpaid work includes domestic work tasks like gardening and tidying, as well as childcare activities. Personal care refers to those physiologically necessary activities such as sleeping, eating, and grooming.

The second step is to determine the poverty rate. In this case, women are considered time poor if their free time falls below 60% of the median free time of the sample of respondents.

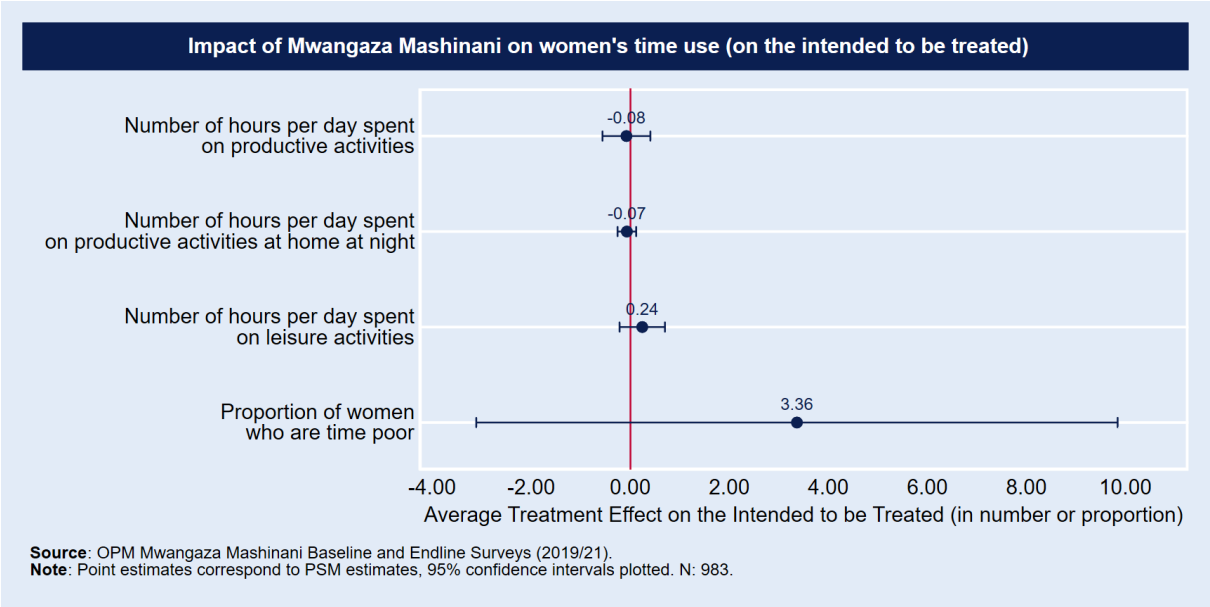
Using 60% of the median leisure time as the threshold, we find that a quarter of women interviewed in the time use module at endline are categorised as time poor, with significantly more women in Kilifi (31%) considered time poor in comparison to Garissa (12%). Overall, this is a significant decrease from baseline, where a third of women were found to be time poor.

Impacts attributable to the pilot project

Despite these changes in women's time use and time poverty between baseline and endline, the impact analysis finds no significant and attributable impact of the pilot project on the proportion of women who are time poor or on the number of hours per day women spend on productive activities, productive activities during dark hours, and leisure activities, among either the intended to be treated or actually treated sample. This is shown in Figure 41 below and Figure 44 in Volume II, where the 95% confidence intervals associated with the point estimates overlap with zero. This suggests that the changes in women's time use that we observe in the treatment group over time would have occurred in the case of the counterfactual. In this instance, the lack of an impact (and therefore the lack of a

negative impact) on women's time poverty is a reassuring finding that the project did not have any negative unintended effects on women's time use.

Figure 41: Impact of the pilot project on women's time use (ITT)



Source: OPM Mwangaza Mashinani Baseline and Endline Surveys (2019/21).
Note: Point estimates correspond to PSM estimates, 95% confidence intervals plotted. N: 983.

5.4.4 Health

The endline and baseline surveys measure three aspects of health related to energy use: experience of eye irritation in the past one month, burns sustained while using lighting fuel in the past six months, and symptoms of ARI in the past two weeks. At midline, only symptoms of ARI were measured. See Box 10 on the measurement and results related to ARI symptoms.

Box 10: Symptoms of ARI – measurement and prevalence

ARI is a leading cause of childhood morbidity and mortality throughout the world. Following the 2014 Kenya Demographic and Health Survey methodology, the prevalence of ARI symptoms was estimated by asking the respondent whether, in the two weeks preceding the survey, any household member had been ill with a cough accompanied by short, rapid breathing and difficulty breathing as a result of a problem in the chest. These symptoms are consistent with pneumonia.

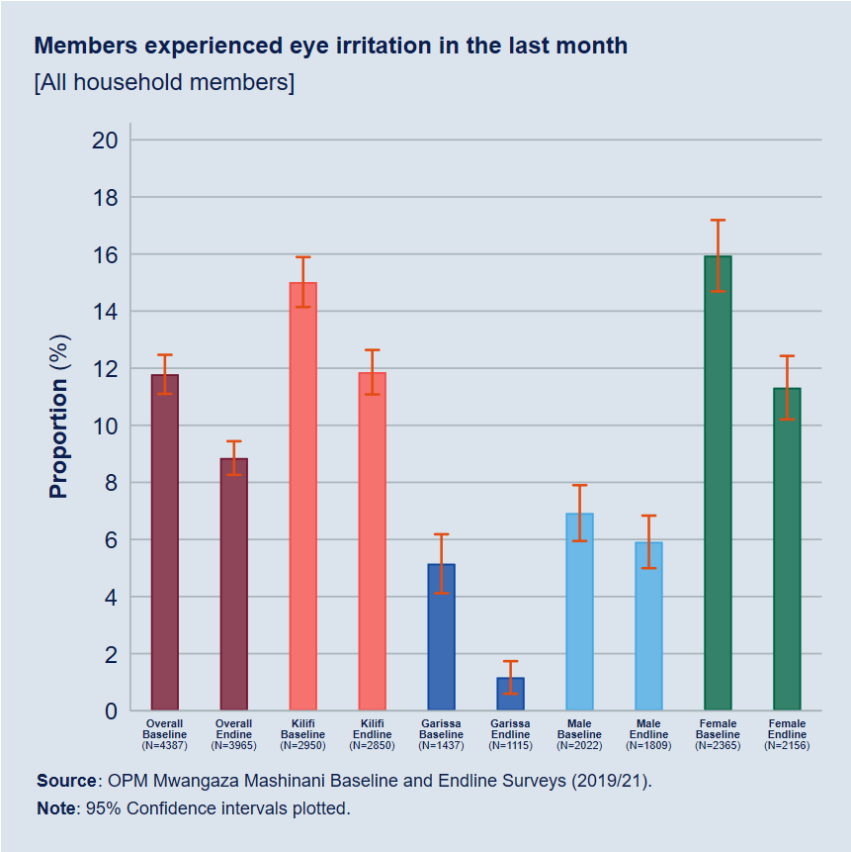
It is worth noting that the data collected on ARI symptoms are subjective and based on the respondent's perception of the illness, without validation by a medical professional.

A negligible proportion (0.6%) of household members experienced symptoms of ARI in the two weeks preceding the endline survey. This represents a decrease from already low levels at baseline (6%) and midline (1.5%). It is worth noting that the endline estimates on household members' experience of respiratory symptoms should be treated with caution given the COVID-19 mitigation protocols that were adopted by the interviewing teams during data collection. As part of the in-person endline data collection, a screening protocol was administered to each household before the interview to check if any household members were suffering from COVID-19 or if the respondent was displaying symptoms associated with the virus. While very few households failed the screening protocol, and as a result were not interviewed, the administration of the protocol might have discouraged some households from reporting COVID-19-related symptoms, given the social distancing measures they would be subjected to if they were found to be displaying symptoms.

At endline, the proportion of household members reported to have experienced symptoms of eye irritation in the month preceding the survey is 9%, down from an already low level (12%) at baseline (Figure 42). When looking specifically at school-going children, we find a greater decrease since

baseline (by 5 percentage points), such that by endline only 5% of school-going children were reported to have experienced symptoms of eye irritation (Figure 43).

Figure 42: Household members experiencing eye irritation (by county and gender, and over time)



Households reported that the overwhelming majority of cases of eye irritation happen while members are cooking themselves (76%) or are present while someone else is cooking (60%). This represents an increase since baseline, where 61% of eye irritation cases were reported to happen when members are cooking themselves, and 45% when someone else is cooking. There has also been an improvement since baseline in the methods household members use to address the symptoms of eye irritation. While 23% of household members experiencing eye irritation at baseline reported doing nothing to address the problem, this has decreased to only 6% of household members at endline.

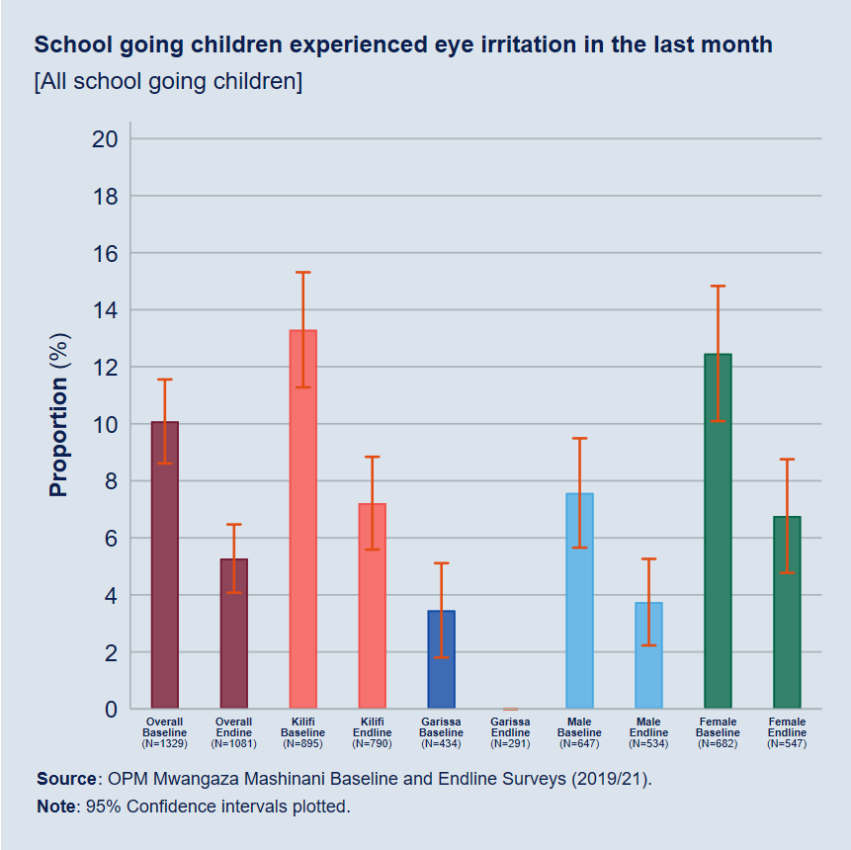
The proportion of household members reporting experiencing burns related to lighting fuel in the six months preceding the survey is negligible (1%), down from a very low level (3%) at baseline.

At baseline there existed significant differences in the proportion of household members experiencing symptoms of eye irritation and burns by gender, county, and age. While the prevalence of both indicators has decreased significantly for all sub-groups since baseline, there remain differences at endline, whereby females, older household members, and Kilifi residents report much higher numbers of incidents compared to males, younger household members, and Garissa residents, respectively. Specifically, twice as many females as males report experiencing symptoms of eye irritation and burns from lighting fuel. This is likely due to the fact that women spend more time in front of open flames, mostly burning firewood, while cooking. While 84% of females who experienced eye irritation reported that it happens while they are cooking, 84% of males who experienced eye irritation reported that it happens while other household members are cooking.

Further, the prevalence of burns in Kilifi is four times greater than in Garissa, and the prevalence of symptoms of eye irritation is more than eight times greater. One explanation for this could be that more households in Garissa cook outdoors or in a separate outhouse (99%), compared to Kilifi (77%).

The average health risk to other members of the household (i.e. those not cooking) is lower when cooking is not done in the main house as their time in contact with high levels of pollution is less. Another factor could be that some households in Kilifi are still using kerosene for lighting, while almost none do so in Garissa.

Figure 43: School-going children experiencing eye irritation (by county and gender, and over time)



Impacts attributable to the pilot project

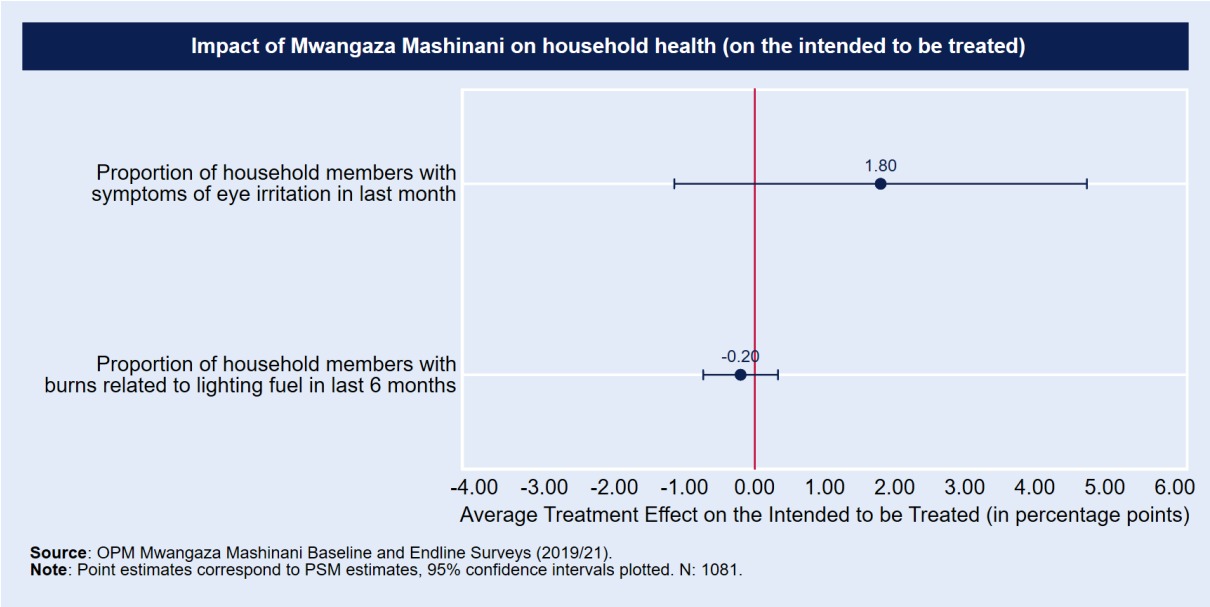
While this improvement in health outcomes since baseline is positive, there is no evidence that it can be attributed to the Mwangaza Mashinani pilot project. Results from the impact analysis do not show an impact on the proportion of household members experiencing eye irritation or burns, for either sample of households that were intended to be treated or actually treated. This is shown in Figure 44 below and Figure 45 in Volume II, where the 95% confidence intervals associated with the point estimates overlap with zero. This suggests that the improvement in health outcomes that we observe in the treatment group over time would have occurred in the case of the counterfactual.[51]

The lack of impact of the pilot project on household members' health outcomes is unsurprising and was expected at baseline, given households' cooking habits. The predominant cooking fuel used by households, firewood, is a far greater contributor to indoor air pollution than lighting fuel (see Section 5.4.1.1). Furthermore, the location of cooking plays a key role in determining the average household member's exposure to indoor air pollution. Households predominantly cook indoors, which includes inside the main house (with or without a partition), in an attached but separate room, or in an outhouse, and this increases the risk to the average household member's health. This practice of cooking indoors has significantly increased over time, from 47% of households at baseline to 63% of households at endline. Furthermore, the majority of cases of eye irritation were reported to have

[51] Note that the impact of the pilot project on the prevalence of ARI symptoms was not measured at endline due to the reliability concerns related to the COVID-19 screening protocol. However, the impact of the project on this indicator was assessed at midline and we found no attributable impact, despite a reduction in the prevalence of ARI symptoms in the treatment sample between baseline and midline.

happened during cooking, as opposed to other activities. In light of these results, substituting solar energy for lighting alone will have limited impact on health.

Figure 44: Impact of the pilot project on household members' health (ITT)



Source: OPM Mwangaza Mashinani Baseline and Endline Surveys (2019/21).
Note: Point estimates correspond to PSM estimates, 95% confidence intervals plotted. N: 1081.

5.5 Sustainability

Box 11: Summary of findings related to sustainability

The assessment of sustainability indicates that there is a high degree of commitment to scaling up the pilot project by the national government. Evidence at the household level suggests that households would struggle with the costs of maintaining the solar devices or replacing them once they reach the end of their lifespan. The issue of financial sustainability will need to be addressed in any scale-up scenario.

- **Stakeholder commitment**: Stakeholders in the MoE, SPS, and DSA have endorsed the pilot project and are interested in scaling it up. KOSAP was widely mentioned as a potential vehicle for scale-up. Solar providers are also interested in exploring new markets.
- **Maintenance of devices**: Many beneficiary households do not have a fully functioning device at endline. Many households have also experienced maintenance issues with their device and have had to have it repaired, though it is not clear if these are minor or major repairs. Households indicated that they are willing to make minor repairs to their device, but they would struggle with making more substantial repairs or replacing their device if it breaks down, due to affordability concerns.
- **Financial sustainability**: The solar devices are expensive products for the target market and are highly subsidised by the project in order to 'seed' the market, create awareness, and overcome the issue of affordability. However, it is not clear how consumer affordability would be addressed in a scale-up scenario.

In Section 5.4, we discussed how households' awareness, use, and perceptions of the positive benefits of the solar device have been sustained since midline. In this section we explore other indications regarding the sustainability of the Mwangaza Mashinani pilot project. Specifically, we discuss the potential sustainability of the pilot project in terms of stakeholders' commitment to scaling up the project (Section 5.5.1), households' capacity and willingness to maintain the solar devices (Section 5.5.2), and the financial sustainability of the solar devices for households (Section 5.5.3).

This section draws on evidence from the quantitative data at endline and midline, and from the qualitative research at midline and the implementation review. The qualitative research conducted in January 2020, and the quantitative midline survey, presented a preliminary understanding of the sustainability of the pilot project with respect to households' ownership and maintenance of the solar devices. This was explored further at endline to better understand households' experience with the solar device two years after receiving it and the implications for sustainability. All of the quantitative data discussed in this section are descriptive and are presented only for the sub-group of households that were actually treated by the project (as opposed to the overall sample intended to be treated).

5.5.1 Stakeholders' commitment to scaling up the pilot project

In this section we provide a summary of the findings presented in the midline evaluation report, drawing on the findings of the implementation review conducted in November 2019, and we include relevant findings from the endline survey (April–June 2021).

At the national level, the MoE and Ministry of Labour and Social Protection (MLSP)[52] (represented by the SPS and DSA) have endorsed the pilot project and would like to see the project scaled up. Stakeholders in both ministries felt that they could run a scaled up version of the project from their ministry (given the alignment with policy objectives in the energy and social protection sectors). However, it is not clear that either ministry is currently in a position to scale up the project as neither ministry has been very involved in either the design or the implementation of the project. In addition, officers at the Department of Children's Services and Department of Social Development, who would be involved with implementation should the project be scaled up through the MLSP, are already very capacity constrained. These constraints are likely to be exacerbated with the roll-out and implementation of the Enhanced Single Registry, Nutritional Improvements Through Cash and Health Education Programme, and economic inclusion pilots under the Kenya Social and Economic Inclusion Project, which are currently ongoing.

As part of the implementation review, KOSAP was widely mentioned as a programme that could take the Mwangaza Mashinani pilot project to scale. However, at that time (November 2019) stakeholders in KOSAP and the MoE, in general, felt that they had not been kept up to date on the progress of the project, and felt that conversations around alignment between KOSAP and the project had stalled, due to changes in management at UNICEF.

The solar suppliers both indicated an interest in scaling up their involvement in the project and both were interested in exploring new markets.[53] The guarantee mechanism was mentioned as a key aspect of the project that would incentivise exploring new markets. There is some evidence from the endline survey that one of the solar providers, d.light, has already started exploring new markets. In particular, as mentioned in Section 5.4.1.2, there has been an increase in the proportion of households in the evaluation comparison group that own a solar lighting device, from 4% at baseline to 27% at endline. These households reside primarily in Kaloleni, Kilifi, and the majority of their devices (70%) are supplied by d.light.

5.5.2 Ownership and maintenance of solar devices

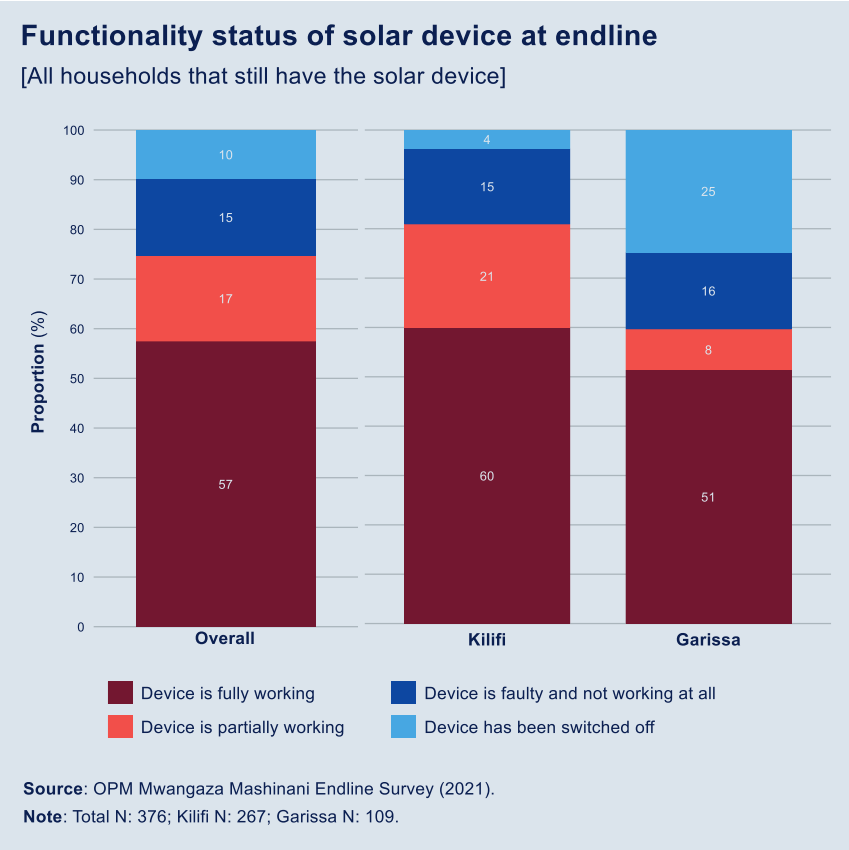
Current functionality status of the solar devices provided by the project

The quantitative midline survey, which took place almost a year after households enrolled in the project, found that almost all beneficiary households (98%) still had the solar device. In terms of the condition of the device at midline, 71% of households had a fully functioning device, 14% had a partially working device, and 15% had a device that was not working at all. By endline, the functionality

[52] At the time of the first phase of implementation and this evaluation the State Department for Social Protection was housed within the MLSP. However, at the time of writing, the State Department has moved to the Ministry of Public Service, Gender, Senior Citizens Affairs and Special Programmes.
[53] Due to budget constraints, only d.light was engaged in the second phase of implementation.

condition of the solar devices has worsened. While 98% of households still have the solar device at endline, considerably fewer households have a fully functioning device and considerably more households have a device that is not working at all, when compared to midline. Specifically, only 57% of beneficiary households at endline have a fully functioning device, while 17% have a partially functioning device, 15% have a faulty device that is not functioning at all, and 10% have a device that has been switched off by the solar providers due to lack of payment (Figure 45).[54] Therefore, in total, a quarter of households at endline have a device that is not operating at all.

Figure 45: Functionality of solar devices (overall and by county)



For households with a device that is not fully functioning, on average the device has been in that condition for 205 days (almost seven months) prior to the survey. This period is higher among the households whose device has been switched off due to lack of payment. For those households, the device has been, on average, switched off for the past nine months, while for households whose device is not fully working for other reasons, the device has been in a faulty condition for the past six months. This is a relatively long period considering that households have only had the solar devices for the past two years. Furthermore, it is worth noting that these average lengths of device malfunction are contained within the time period between midline and endline, while project-related activities ended in the surveyed communities at midline.

Households whose solar device is not fully working for reasons other than being switched off were asked about which parts of the device were not working. The most common parts of the device that were reported to not be working were the wires (28%), lamps (26%), battery (20%), and radio (9%). About 15% of households did not know what issue is causing the device to not operate fully. The main issues differ depending on whether the device is partially not working or completely not working. For those with a partially working device, the main issues reported were with the lamps, wires, and radio,

[54] It is not possible to break down the 15% of households at midline with a completely malfunctioning device into those with a switched off device and those with a faulty device, as the reasons for the device not working were not collected at midline.

while for households with a completely malfunctioning device the main issues reported were with the battery and base unit, or they were unknown to the household.

While there are no observable differences in the current condition of the solar device by gender of the household head or type of cash transfer, there are big differences by county (Figure 45). Compared to Kilifi, Garissa has a significantly higher proportion of beneficiary households with a device that has been switched off owing to lack of payment (25% in Garissa versus 4% in Kilifi). On the other hand, Kilifi has a higher proportion of households with a partially working device (21%), compared to Garissa (8%). There are no significant differences between the two counties in the proportion of households with a fully functioning device, or with a device that is not working at all for reasons other than being switched off. Furthermore, significantly more households in Garissa (46%) reported not knowing what the main issue with their faulty device was, compared to Kilifi (7%).

Finally, among households whose device has not been switched off due to lack of payment, 87% reported fully owning the device at the time of the endline survey. The findings from the qualitative research at midline suggest that poor understanding of the programme may explain why 13% of households reported not owning their device despite completing the repayments. While BWCs and CCs in the qualitative sample were aware that households need to make six payments before they fully own the device, few beneficiaries reported knowing how many times they need to pay in order to fully own the device. Payment delays, resulting in 'double' payments, did not help to instil clarity around how much or how long beneficiaries have to pay for their device. The lack of clarity around payments suggests that beneficiaries do not know when they will fully own their devices, which constrains not only their sense of ownership but also their agency in the transaction.

Maintenance needs of the solar devices

Among beneficiary households whose device has not been switched off for lack of payment, almost half reported repairing their device at least once since receiving it and 12% reported repairing it more than once. More households have had their device repaired in Kilifi (52%) than in Garissa (35%) over these last two years. There is no significant difference by gender of household head or cash transfer type.

The most common reported component of the device that requires fixing is the wires (56%), followed by lamps (20%), battery (13%), radio (6%), and USB charging (6%). Generally, the majority of households reported making the repairs themselves or asking someone in the community to do so. Specifically, among the sample of households that have repaired their device in the past, 54% did the repair themselves, while 22% requested a friend or family member repair their device, and 16% had the community champion repair the device. On the other hand, 16% of these households took their device to a local technician to be repaired, and 13% had the solar providers repair the device. It is not clear if the reliance by households on themselves and community members to make repairs, as opposed to the solar providers, is because the issues they faced with the device were minor and did not necessitate involving the solar providers or because households are not aware that solar providers are primarily responsible for maintenance issues (which was the case at midline among the majority of beneficiary households) or do not have easy access to them. The fact that the majority of households (66%) have not incurred any costs for the repairs they have had to do to date suggests that the majority of issues households have faced with the devices have been minor issues that can be fixed by the households themselves or by others in the community. However, it is likely that the findings are explained by a combination of these factors and further qualitative research would be beneficial to understand the extent to which the device issues faced by households are minor or major, and to understand the burden of device maintenance on households.

It remains the case, however, that almost half of beneficiary households with a switched on device have faced an issue with the device that required fixing, whether it was minor or major. This is corroborated by the qualitative research findings from early 2020. Interviews at the time revealed that households are careful with the devices and are wary of young children breaking them, which is why children are typically not allowed to operate the devices themselves. Despite taking great care with

their devices, households experienced a number of maintenance issues that caused their devices to stop working. For example, a common issue was the breaking or fraying of wires, which are susceptible to inclement weather or damage by animals (for example, rats chewing wires). CCs in both Kilifi and Garissa said that they could fix smaller problems like broken wires for the households themselves, but for more technical problems they would ask households to contact the solar providers directly.

Continued presence of project community structures

The continued presence of local structures that are part of the pilot project, such as CCs and BWCs, is important for the sustainability of the project given the aforementioned findings on the constant care that the solar devices will likely require over their lifetime. The situation at midline was not very promising in relation to households' engagement with the project community structures as the majority of households were not aware of the presence of some of these structures in their community (and this unawareness was particularly marked in Garissa) and the majority were not relying on the appropriate contact person for problems related to device maintenance or cash top-ups.

There is no evidence that the presence of project community structures has decreased since project activities ended in the sampled communities at midline. On the contrary, it seems that households are more aware at endline of the presence of these structures. Specifically, at midline only 44% of households reported that there was a CC in their area, while 32% reported that there was no CC and 24% did not know. At endline, 59% of households report the presence of a CC, while 29% report that there is no CC and 13% do not know. Similarly, while 20% of households at baseline reported that there was a BWC in their community, this has increased significantly, to 54%, at endline.

On the other hand, households at endline are contacting the CC less frequently than at midline. While at midline 74% of the households that were aware of the presence of a CC contacted them at least once a month, this has decreased significantly to 40% at endline. Significantly more households at endline (25%) are contacting the CC less than once in every four months, compared to at midline (7%).

The situation is also very different across counties, with a significantly lower presence of project community structures in Garissa than in Kilifi. While 74% of households in Kilifi report that a CC is present in their area, only 21% of households in Garissa do. Half of households in Garissa report that there is no CC in their area. This is similar for BWCs: 71% of households in Kilifi report that there is a BWC in their community, compared to only 12% of households in Garissa.

Willingness of households to repair and replace the solar devices

The qualitative research at midline found that while households demonstrated a strong need for the solar devices, it was not evident that they would use their own funds for major repairs or replacements after the project ended, especially since beneficiaries believed they would have to sell their produce or stretch their savings to afford repairs. Some interviews suggested that the beneficiaries would like to maintain the devices beyond the completion of the Mwangaza Mashinani pilot project. However, at the time of undertaking the qualitative research, many beneficiaries had not yet encountered the need to use personal financial resources to address substantial maintenance issues.

At endline, we asked households if they are willing to repair or replace their solar device, for both households whose device is currently partially or completely not working, and more generally as hypothetical scenarios for all beneficiary households.

For households whose device needs replacement at endline, only a quarter reported a willingness to buy a replacement device, with the main reason for not buying one being a lack of funds. Households are more willing to repair their devices. Specifically, for households whose device is not working at endline but requires a repair, 66% are willing to repair the device. However, there is a big difference in this proportion across counties (75% in Kilifi are willing to repair their faulty devices versus 36% in Garissa), and overall it shows that not all households are willing to repair their faulty devices. The main reason provided by households that are not willing to make the repair is lack of funds. Few

households also reported other reasons, including not knowing where to get their device repaired or not having a convenient or close place to take their device for repair. When asked who they would go to for repairing the device, households said solar providers (30%), followed by CCs (26%) and local technicians (25%), while 14% do not know who they would go to.

Figure 46: Willingness to pay for repair or replacement of solar device (overall)

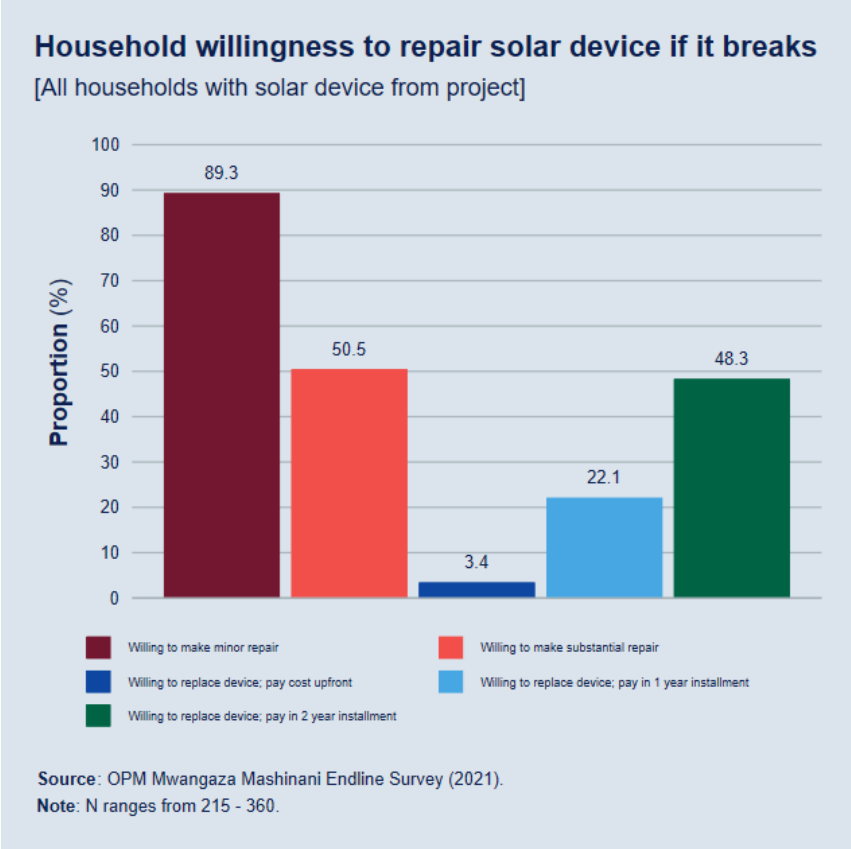


Figure 46 presents results from the hypothetical scenarios that were presented to beneficiary households at endline to gauge their willingness to repair or replace their solar devices should they stop working today. Households were provided with benchmark prices for the repair and replacement.[55] When asked if they would be willing to make a minor repair to their solar device that might cost about KSH 200, the overwhelming majority of households (89%) answered that they would be willing to do so. Most of these households (63%) reported that they would be able to use money from their income to cover the cost of the minor repair, while 18% reported they would have to wait longer for the repair until they had saved up the money, 17% reported that they would have to borrow money for the repair, and 15% said they would have to use money from their savings. On the other hand, considerably fewer households (51%) reported a willingness to repair the device should it stop working and require a substantial repair that might cost around KSH 3,300. The proportion of households reporting the different sources of funds they would use to make a substantial repair are more or less similar to those for the minor repair.

When it comes to willingness to replace the solar device should it stop working completely, at a cost of about KSH 13,000, 3% of households said that they would be willing to replace the device and pay the full cost upfront, while 22% said they would be willing to pay the full cost of a replacement device over a one-year instalment period (which is the current model the solar providers are using in this target market), and 48% said they would be willing to pay the full cost over a two-year instalment period. While the proportion of households that are willing to pay for a replacement device upfront is similarly very low across the two counties, significantly fewer households in Garissa (37%) indicated a

[55] These benchmark prices were provided to the evaluation team by E4I during the endline design phase.

willingness to replace the solar device using a two-year instalment plan, compared to Kilifi (53%), and similarly fewer households in Garissa (17%) indicated a willingness to replace the solar device using a one-year instalment plan, compared to Kilifi (25%), though this difference is weakly significant. The proportion of households reporting the different sources of funds they would use to replace the device are more or less similar to those for the minor repair, but there was an additional 16% of households who said they would have to sell an asset to afford the purchase of a replacement device.

Lack of affordability was the reason provided by all households who reported their unwillingness to make the minor or substantial repair, or to replace the device.

5.5.3 Financial sustainability

In this section we provide a summary of the findings presented in the midline evaluation report, drawing on the implementation review findings conducted in November 2019, and we include relevant findings from the endline survey (April–June 2021).

The Mwangaza Mashinani pilot project provides highly subsidised products to vulnerable households, which is necessary in order to 'seed' the market and to overcome the issue of the affordability of accessing solar energy. However, these devices are expensive products for the target market and, even on a pay-as-you-go basis, affordability is a challenge for households. At midline we found that only 40% of households paid the KSH 250 commitment fee using their own money. Further, interviews with the solar suppliers from midline also indicated that very few households made repayments during the time of the Inua Jamii payment delays, which led to many households (82%) having their device switched off at least once after receiving the solar device. And while the majority of these households eventually had their devices switched back on, there remain a sizeable minority of households at endline (10%) with a device that is still switched off. In addition, the value of the cash top-up provided by UNICEF is high relative to the Inua Jamii payments (at more than 50% of the value of the regular Inua Jamii transfers). Hence, without the subsidy, affordability will remain a constraint.

Further, solar products require periodic maintenance and it is likely that the lithium batteries will need replacement after three to five years' use. This maintenance would need to be paid for by households themselves, and can be costly (e.g. US$ 20 to replace a battery). On top of this, some maintenance issues will also require households to pay for the services of people who are able to undertake the repairs. This is corroborated by the endline findings, which indicate that many households are unwilling to make substantial repairs to their devices or replace them due to lack of funds (see Section 5.5.2).

Section 5.4.3.3 has also shown that households' income has not improved as a result of the pilot project. Further, while households are making substantial monthly savings on energy costs for lighting and charging mobile phones (KSH 400) as a result of the project (Section 5.4.1), these may not always be sufficient to cover the costs of major repairs. The qualitative research at midline also found that households typically spend these energy cost savings on short-term needs like food and school supplies. The energy cost savings are also considerably lower than the KSH 2,100 bi-monthly top-up that households used to pay for the solar device, meaning that households would struggle to afford replacement devices when the existing ones reach the end of their lifespan, at the least in the short to medium term before households are able to meaningfully build their savings.

In a scale-up scenario, it is not clear how consumer affordability would be addressed. For example, KOSAP currently addresses affordability on the supply side by introducing results-based financing for solar devices and cook stoves. The programme does not have a subsidy element, although stakeholders at KOSAP acknowledged that if they are to reach the most vulnerable households the programme might need to include a subsidy. Therefore, it is important for the Mwangaza Mashinani pilot project to continue to engage with KOSAP around whether and/or how a subsidy approach could be integrated into the programme, by presenting a viable and tested implementation model that could be integrated into KOSAP to ensure that the most vulnerable households are able to afford clean energy lighting solutions.

6 ASSESSMENT OF THE TOC

This chapter provides a final assessment of the pilot project's ToC on the basis of the evidence from the quantitative and qualitative research activities undertaken throughout the course of the evaluation, and synthesised at endline.

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Rom, A., Gunther, I. and Harrison, K. (2017) 'The economic impact of solar lighting: Results from a randomised field experiment in rural Kenya', Acumen. https://acumen.org/wp-content/uploads/2015/10/Report-The-Economic-Impact-of-Solar-Lighting.pdfFigure 47 shows the ToC diagram, and provides a visual indication of our assessment of whether or not key aspects of the ToC were upheld. It also includes additional assumptions, outcomes, and impact boxes, which emerged from the evaluation evidence.

While the findings presented in this report articulate the quantitative and qualitative findings collected across the DAC criteria and evaluation questions, we highlight here some of the key insights emerging regarding the ToC itself, including its assumptions and envisaged causal links.

What worked?

The findings presented in this report provide a clear indication of the pilot project's achievements, which also reflect 'what worked' along the project's ToC, including which assumptions and causal mechanisms were validated and ultimately led to observed impact at the beneficiary level. As discussed in Sections 5.4.1.2 and 5.4.1.3, awareness about the benefits of solar home systems further improved and households with functioning devices used them for both lighting and charging mobile phones. This proves that the assumption on households valuing solar energy and solar home systems was correct. Similarly, it is also confirmed that solar home system providers are interested in serving remote communities when a market is created. This was another key assumption that is also clearly validated by our findings on the control group, which show a steep increase in ownership of solar home systems among control households, which were not targeted by the pilot project but were reached by suppliers as a likely spill-over of the project's activities in nearby locations. The most

important evidence of project impact comes from the child study hours and education indicators, discussed in Sections 5.4.2.1 and 5.4.2.2. Again, in this case, a crucial assumption underpinning the ToC is also validated as children were not able to study as much during the day and the lack of clean and cheap lighting was indeed a barrier to increasing study hours at home. Solar home systems were able to address this issue directly, which then led to a positive impact on children's study hours at home, and on related education outcomes as a consequence. Both quantitative and qualitative evidence suggests that this impact unfolded along the ToC causal chain, which was underpinned by relevant assumptions and correctly predicted by an impact pathway, beginning with project activities and moving through outputs and outcomes at community and household levels. The final impact on children's enhanced ability to study during dark hours, and improvements in their school attendance and promotion, is the biggest success of the pilot project. It also represents the most evident validation of a central impact pathway described in the ToC.

What was disproved?

As shown in Figure 47, a significant number of assumptions and causal mechanisms envisaged in the ToC were found to be either problematic or completely disproved by the evidence gathered as part of the evaluation. As discussed in Section 5.4.3, the endline results show that there is no impact attributable to the pilot project on livelihood activities or income. This impact was supposed to be achieved mainly through savings from a reduction in net expenditure on energy, as well as from extra income derived from additional livelihood activities based on the use of solar home systems. However, our findings clearly show that, after the initial boost in mobile phone charging activities measured at midline, there is no longer-term impact on livelihoods that is sustained until endline. Similarly, although savings were made thanks to the cheaper lighting and charging using solar home systems, these were not substantial enough to detect a significant impact of the pilot project on household income. The link between related outputs (e.g. acquiring the solar home system) and outcomes (e.g. diversifying livelihood activities) was therefore not shown to be upheld.

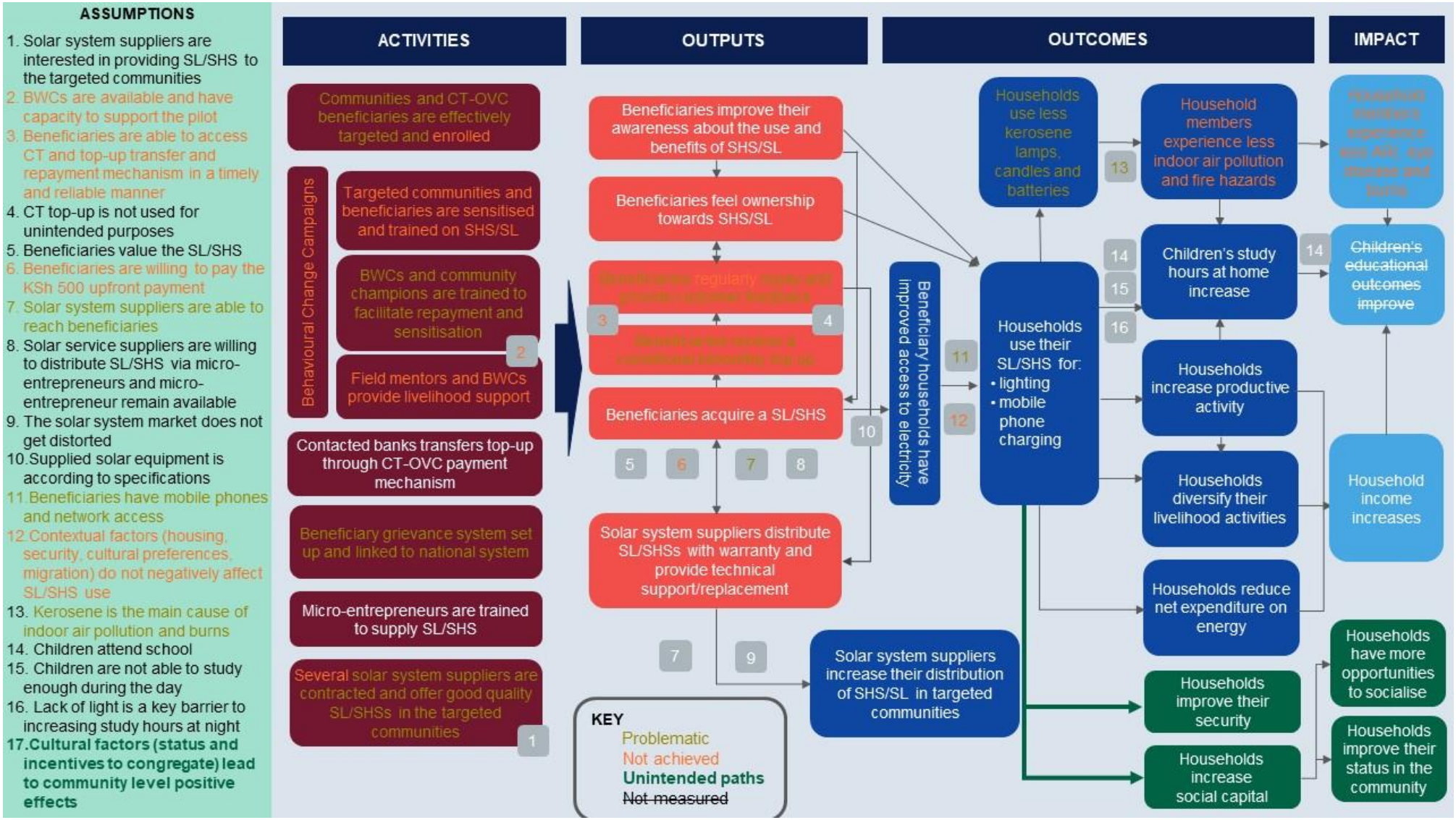
Apart from the relatively low power of the solar home systems supplied as part of the pilot project, another factor compromising the project's impact on livelihood activities and income was likely to be the lack of training and mentoring support focusing on livelihoods. This is listed in the ToC as one of the pilot project activities expected to make a difference, and to help beneficiary households progress along the ToC causal links towards impact, but it was never fully implemented. More broadly, BCC activities, including livelihoods support, but also training and sensitisation on solar home system functions and repayment protocols, among other things, occupy a sizeable part of the project activities described in the ToC. Hence, as the BCC was arguably the component with the weakest delivery of the pilot project (see Section 5.2.1), this had a negative effect on a number of related outputs and outcomes linked to the BCC in the ToC. These include, for instance, households' levels of awareness concerning the device repayment process and timeframe, as well as their capacity to maintain the solar home systems or to find technical assistance for that purpose. In turn, this has a negative effect on the sustainability of the intervention, and of its impacts, depending on the lifespan of the solar home systems.

Finally, the lack of impact on health indicators, presented in Section 5.4.4, is another example of a ToC impact pathway that was disproved by the evaluation. While the assumption on kerosene (and other fuels, such as paraffin and firewood) being the main cause of indoor air pollution was correct, acquiring a solar home system did not allow households to reduce the use of kerosene lamps sufficiently. This is because cooking, the main source of indoor pollution (as well as of burns and eye irritation), continued to be based on kerosene or other polluting fuels. As a result, the parallel use of solar home systems for lighting did not affect households' health, which means that neither outcomes nor impacts associated with health in the ToC causal chain were reached.

What was unexpected?

The endline assessment of the Mwangaza Mashinani ToC also highlights the fact that the original ToC formulated at inception did not account for some additional effects of the pilot project, which were uncovered through the evaluation findings. In particular, Section 5.4.1.3 discusses the important positive effects of the project reported by households on aspects such as security and social well-being. The use of solar home systems have led to a sense of improved security and increased social capital. Households feel safer, have more opportunities to socialise, and have seen their status in the community improve thanks to their dwellings being lit up at night and thus becoming a place for gathering with other households and members of the community. This is also likely to be one of the causes of spill-over effects detected within treatment villages (as opposed to spill-overs in control villages), where a sizeable proportion of households not enrolled in the pilot project have decided to buy a solar device with their own resources, as mentioned in Section 5.4.1.2. These results are thus added to the ToC diagram in Figure 47, as unintended outcomes and impacts of the pilot project. We also include a new related assumption, arguing that cultural factors associated with the use of solar home systems should be expected to have positive community-level effects for both beneficiary households and other households in the community. This assumption could be usefully included in the ToC of future similar projects.

Figure 47 Endline assessment of ToC



7 CONCLUSIONS AND LESSONS LEARNED

The analysis in this report draws on findings from the baseline, midline, and endline surveys, a midline round of qualitative research, the implementation review conducted at national level, and a VfM analysis. In this chapter, we summarise the conclusions and lessons learned based on the findings presented in Chapter 5, structured along the DAC criteria covered by the evaluation.

7.1.1 Relevance

Overall, our findings suggest that the pilot project's objectives are relevant for the targeted households, solar suppliers, and the GoK. Specifically, the project's aim to improve the affordability of small solar devices is relevant for households, who are found to lack access to modern energy sources for lighting and charging mobile phones. Our findings confirm that affordability is the key constraint faced by these households. However, it is also important to point out that affordability remains a constraint at endline, as most households are still not in a condition to be able to replace the solar device if it stops working.

The project also aims to develop markets for solar energy by increasing the penetration of solar products in previously underserved communities. We find that the de-risking mechanism offered to the solar suppliers provides a sufficient incentive for them to explore new remote markets. This is further confirmed by the positive spill-overs that we detect in both treatment and control areas, where the proportion of non-beneficiary households that decided to purchase a solar device independently has been found to increase from baseline to endline.

Finally, we find that the pilot project is aligned with the GoK's priorities for social protection and energy in terms of promoting the realisation of the economic and social rights of all Kenyans, and supporting households to start to move towards accessing acceptable minimum levels of energy services, respectively.

7.1.2 Effectiveness

Overall, throughout the cycle of the pilot project's implementation, we find that outreach and communications have been weak, and that this has undermined other aspects of the project's service delivery (e.g. repayments). First, chiefs felt they were not adequately consulted or sensitised about the project prior to implementation, despite their primary role in supporting Mwangaza Mashinani beneficiaries. Second, the lack of communications and training on the payment system has led to confusion around entitlements and the process of making repayments, with community leaders and project structures feeling that they do not have sufficient knowledge to support households effectively. Third, despite an explicit focus of the pilot project on improving outcomes for women, there is no explicit gender or gender equality and social inclusion framework in the design of the project – in particular, as part of the BCC strategy.

The baseline survey results indicate that the targeting was largely successful, with most households selected through the verification exercise meeting the eligibility criteria. Community leaders also perceive the project to have enrolled vulnerable households. However, due to the small scale of the pilot project and the categorical targeting criteria there was also the perception that not all vulnerable households had been included (see Box 12).

The pilot project was able to meet and exceed its enrolment target in the first phase of implementation. However, the process of enrolment differed by community, which undermined the intended registration and targeting process. One-third of the baseline 'treatment' sample did not enrol in the project, with more eligible and registered households ultimately not enrolling in the project in Garissa than in Kilifi. In addition, many beneficiaries used money provided by project staff or family/friends to pay the commitment fee for the project themselves, particularly in Kilifi, which undermines the project design to ensure beneficiaries were serious and committed. Finally, while households were aware that there

were two devices offered through the project, it is not clear that households made an informed selection, due to low levels of literacy and a lack of information about the solar devices.

Box 12: Piggybacking on the Inua Jamii

Piggybacking on existing government systems is likely to enhance the harmonisation of service delivery and to be a sustainable solution if the GoK is willing to take on ownership and scale up the project. However, in preparation for scale-up, the pilot project should consider the appropriateness and implications of continuing to piggyback on the Inua Jamii's delivery systems.

First, by targeting only beneficiaries of the Inua Jamii, the Mwangaza Mashinani project targets only vulnerable households that meet the Inua Jamii's categorical targeting criteria, while also inheriting the Inua Jamii's exclusion errors. Given the project's focus on enhancing access to modern energy for vulnerable households in underserved communities, a more inclusive approach to targeting that covers both Inua Jamii and non-Inua Jamii households could be better suited to achieving this objective. For example, the project could adopt a geographic targeting approach to cover all households residing in underserved communities. Once rolled out, the Enhanced Single Registry can also be used for targeting vulnerable households.

Second, expanding the eligibility criteria would also address the inherent tension between integrating new interventions with the Inua Jamii and supporting vulnerable households that do not receive support from the cash transfer programmes. On the one hand, layering the Mwangaza Mashinani intervention on top of the existing cash transfer programmes is likely to enhance the resilience of Inua Jamii beneficiary households. On the other hand, there is a preference, at county level, to avoid 'double dipping', by spreading support to vulnerable households that do not benefit from the Inua Jamii (Gardner *et al*., 2020).

Finally, the Inua Jamii suffers frequent payment delays, which are passed on to the Mwangaza Mashinani project and thus threaten the ability of households to make repayments for and maintain their devices (see Section 5.2.4) To avoid this, the project could continue to use Inua Jamii bank accounts to make payments, while de-coupling the timing of the payments from the cash transfer programmes, as discussed during the implementation review. If the project's eligibility criteria were to be expanded beyond beneficiaries of the Inua Jamii, the project could also look to using other means to pay beneficiaries. For example, the COVID-19 response has shown the potential of using M-Pesa, and other mobile money platforms, to provide cash support to vulnerable households (Doyle, 2020).

7.1.3 Efficiency

County-level coordination appears to be more efficient than at the national level. The design phase of the project would have benefitted from more involvement by the suppliers and other relevant stakeholders, including the MoE/KOSAP, who could have helped to shape the repayment terms and products, rather than responding to prescribed parameters. At the county level, technical working groups are said to be well attended and active, creating good political buy-in and commitment from county-level stakeholders. The project has also coordinated with local structures involved in the implementation of the Inua Jamii.

At the community level, we find that the majority of households are not aware of the CC in their area. Where they are aware of the CC, they frequently contact them for support and to raise issues. When utilised, CCs are seen to provide requisite information to Mwangaza Mashinani beneficiaries, to support on technical issues related to the solar devices, and to represent the beneficiaries collectively. More households in Kilifi reported that there was a CC in their area, compared to households in Garissa, which is likely to have had an impact on service delivery. Indeed the delivery of the pilot project has been less successful in Garissa than in Kilifi, as suggested by a number of implementation indicators discussed in this report.

In the period under review, the VfM performance of the pilot was consistent with the agreed standards for 'good' economy, 'average' efficiency, and 'average' cost-effectiveness. However, the expected VfM performance of the programme at scale is on track to be 'good' for all three dimensions, including efficiency and some aspects of effectiveness, provided current performance levels are maintained and a number of specific conditions hold.

In terms of economy, the pilot project has managed to minimise the transaction costs of the cash transfers, as well as operational and staff costs related to UNICEF's activities. However, contractual services have cost more than expected. While the project followed sound procurement practices in selecting the solar suppliers, the final cost of the solar products was above the budgeted amount.

In terms of efficiency, the majority of activities have been implemented within budget, although the pilot project allocated more resources to set up and inception activities, as well as implementation, compared to the budget. This was due to delays in the procurement practices and challenges emerging from contextual factors, some unforeseeable. Despite the initial delays, by June 2020 most logframe targets had been achieved. Nonetheless, 22% of enrolled households decided not to purchase the solar device and 30% of beneficiaries did not make repayments for the device regularly.

Finally, the pilot project meets the definition of providing 'average' cost-effectiveness in relation to education and energy. Excluding pilot-related costs, it is estimated that the cost of the project requires US$ 11.40 to be consumed to increase a child's attendance in school by one day. Further, it costs US$ 2.30 to increase a child's study time by one hour at night. In relation to energy use, Mwangaza Mashinani households are benefiting from an average of 3.4 hours of extra energy use per day. The cost-effectiveness indicator suggests that it costs US$ 0.13 for one extra hour of energy using solar devices as an extra source of energy, which is lower than the cost of using mini-grids as an alternative source of renewable energy.

7.1.4 Impact

Practically all households with a solar device at endline are aware of some of the key benefits of solar energy. Although awareness was already high at baseline, this still represents a substantial increase in the appreciation of the benefits of solar energy over the course of the pilot and evaluation. Interestingly, compared to midline, more households at endline stated that benefits of solar energy are providing better-quality lighting, allowing children to study in dark hours, and making household members feel safer. These indications are confirmed by our findings on project impact.

We find that the pilot project has had a positive impact on energy costs, reducing household expenditure both on energy for lighting as well as on charging mobile phones. The resulting cost savings are equivalent to approximately KSH 400 per month, which is a significant saving for households enrolled in the project, as it represents around 20% of the Inua Jamii amount. The qualitative research found that households use the money saved primarily to buy food and school supplies. Our quantitative impact analysis further suggests that studying and schooling are two areas on which the pilot project has had a very positive impact.

We find that the Mwangaza Mashinani pilot project has increased the time spent by children on studying outside of school. In particular, the project has had a positive impact on the amount of time spent per day studying at home. The impact is even bigger when focusing on the amount of time spent studying in dark hours, when the use of light is most needed. The impact is also substantial in magnitude, as it amounts to roughly 13 minutes of study time at night, which in turn represents an increase of around 43% from baseline to endline. We also find that the impact of the pilot project extends to education outcomes. The project has had a positive impact on the proportion of children attending school, and on grade promotion. Rather than increasing attendance, though, our results show that the project has prevented a drop in attendance among children in beneficiary households, when compared to those in the control group. This is a positive achievement, especially when accounting for the additional challenges to schooling posed by the COVID-19 pandemic. It seems reasonable to suggest that having more opportunities to study at home might have had a positive psychological effect and encouraged children to continue going to school. Previous research on cash transfers in Kenya has already demonstrated that positive impacts on psychosocial well-being can lead to further positive impacts on educational performance.[56] It is also possible that at least some of

[56] See Attah, R., Barca, V., Kardan, A., MacAuslan, I., Merttens, F. and Pellerano, L. (2016) 'Can Social Protection Affect Psychosocial Well-being and Why Does This Matter? Lessons from Cash Transfers in Sub-Saharan Africa', *The Journal of Development Studies*, DOI: 10.1080/00220388.2015.1134777. http://dx.doi.org/10.1080/00220388.2015.1134777

the savings made through the reduction in energy expenditures might have helped cover school costs too. It is clear from these positive findings that education is a key area for which the pilot project has been very impactful. Together with the results of the cost-effectiveness analysis discussed above, this therefore suggests that the focus of the pilot project on education is correct and should be maintained in future phases and expansions.

For the other impact areas investigated as part of the endline evaluation, we find no impact that is attributable to the project. There is no direct impact on livelihoods or income, with the low power output associated with the project solar devices at least partially explaining this finding. It is worth pointing out that at midline the evaluation had found an impact of the pilot project on the number of working household members and the number of productive activities. The fact that this impact was not sustained over time seems to imply that the livelihood activities that can be started when the devices are received, mostly charging mobile phones, may provide some immediate additional income but are unlikely to lead to a steady or reliable revenue expansion. As more households acquire similar devices, which was in fact a stated objective of the market component of the pilot project, the local market gets saturated and this results in a reduction in the demand for this service and indeed the amounts that can be charged.

The project has had no impact on women's time use either, which is also in line with the findings on livelihoods and income, as we do not see any impact on women's time spent on productive activities, either during the day or in dark hours. A positive side-effect of this lack of impact is that the project has not led to an increase in the proportion of women who are time poor. This was a potential risk, as solar energy could have contributed to time poverty among women, who are usually responsible for domestic work and other unpaid activities.

Finally, we find no impact on health. This had already been clearly highlighted by the midline results and is unsurprising since the pilot project has not changed the cooking habits of beneficiary households, which continue to rely on polluting cooking fuels. Hence, substituting solar energy for lighting alone should not be expected to have an impact on health.

As also mentioned in the assessment of the ToC in Chapter 6, the pilot project has had additional unintended positive effects that were not envisaged at the design stage of the project or evaluation. We find that the solar devices improve the sense of security against theft, as well as wild animals that are put off by the light. We also find that project beneficiary households believe that the solar devices provide them with a greater social standing in the community. This is due to the better social status associated with having some form of electricity, but crucially also to the fact that their homes become places for gathering with other households and members of the community, which increases their opportunities to communicate and socialise. Finally, households whose device includes a radio function also reported that this has improved their access to information concerning politics, society, and government policies, including on public health, which of course is important in the context of COVID-19 and associated regulations. Although our analysis of these additional effects does not amount to a full estimation of impact attributable to the project (as there is no possible comparison with control households that were not given the project devices), it clearly points to the role that this type of intervention can play at the community level, with social capital being central to the project's success.

7.1.5 Sustainability

National-level findings suggest that stakeholders are broadly supportive of and endorse the scale-up of the Mwangaza Mashinani pilot project, as it is aligned with priorities in both the energy and social protection sectors. However, in any scale-up scenario, affordability of the product for this market demographic will continue to remain a challenge. Possible scale-up channels, such as KOSAP, will need to consider whether and how subsidies can be used to reach the most vulnerable households.

Sustainability questions at the household level could at least partially be addressed by considering the results of the additional final round of endline data collection, which took place approximately one year after pilot project activities ended. At endline, around a quarter of beneficiary households have a

device that is not functioning at all. While some households have had their devices switched off due to a lack of payment, other households reported a number of issues with the device that mean it is not fully working, including problems with the wires and battery. Most households reported making the necessary repairs themselves or asking someone in the community to do so, which implies that many of the issues encountered to date have been relatively minor. However, we also find that for those households whose device needs replacement, only a quarter of households reported a willingness to buy a replacement device, with the primary reason provided for not buying a new one being the lack of funds to do so. It is also worth pointing out that elements of these solar devices, notably the battery, have a definite expected life span (three to five years), and will need to be replaced eventually, even if the device itself is still functioning. We also note that while ownership of a device provide households with savings (Section 5.4.3.3), these are substantially less than the amounts required to purchase a replacement system. This confirms that the cost savings from using solar over kerosene lighting are not sufficient to resolve the long-term affordability issue as regards replacing devices.

In order to overcome the issue of affordability of accessing solar energy and to 'seed' the market the Mwangaza Mashinani pilot project subsidised products provided to poor households. On the one hand, this addressed the initial cost issue, thus allowing a large number of eligible vulnerable households to acquire a solar device. On the other hand, it also encouraged solar suppliers to enter a previously unexplored market, expanding their reach to households not covered by the pilot project. Summarising these experiences, we can say, in brief, that while households are found to appreciate the benefits of owning a solar device and their sense of ownership can be considered high, affordability remains a serious constraint on the sustainability of project impacts once the devices need proper repairing or replacing. Therefore, some form of subsidy for households and some risk mitigation strategy for suppliers should feature in any future scale-up plan.

8 RECOMMENDATIONS

In line with the objectives of the evaluation, we present recommendations for the pilot project in the second phase of implementation, during the scale-up, or for other programmes with similar objectives or implementation modalities. Many of the operational lessons and recommendations discussed here were previously presented in the midline evaluation report and we include them in this report for completeness. These recommendations were developed throughout the baseline, midline, and endline phases of the evaluation, in consultation with OPM's sector experts who were part of the evaluation team, as well as through consultative workshops and dissemination meetings with national- and county-level stakeholders including the GoK, development partners, and the implementing consortium.

Key Recommendation 1: Articulate the policy objective for the project

Before scale-up, the GoK needs to clearly articulate the overarching policy objective of the project in order to determine whether the project is scaled up through the MoE or the State Department for Social Protection within the Ministry of Public Service, Gender, Senior Citizens Affairs and Special Programmes (although, inevitably, the project will require both ministries to work together). Being clear about the objectives of the policy is important, both for the reason of defining the lead agency, but also for other reasons such as accountability (e.g. monitoring performance against objectives).

Key Recommendation 2: Tweak the project design to further address affordability constraints

To achieve the goal of universal access to minimum electric lighting services, the MoE will need to actively address demand-side constraints on accessing off-grid energy (e.g. through KOSAP). In particular, the findings of this evaluation have shown that for vulnerable people, affordability remains the key constraint on purchasing solar devices for lighting even when the products are available. Therefore, during the design phase of the project (in its second phase, at scale, or when adapted for similar programmes), project implementers should consider whether and how affordability can be further addressed. Examples include the following:

- The project could consider reducing or removing the commitment fee altogether as we find that although the majority of households did not pay the fee themselves, they continue to look after and use their device frequently at endline. If the commitment fee is retained, households should be given sufficient warning that a commitment fee will be required to enrol in the project, such that they are able to save the money.
- The project could try to negotiate a longer repayment period with suppliers to reduce the monthly repayments households need to make. This would help to off-set the cost of the monthly repayment by bringing households' monthly savings on energy expenditure from using solar devices closer to the monthly repayments for the solar device.
- The project could consider offering a wider range of solar products to beneficiaries, including cheaper, lower-tier solar solutions (e.g. solar lanterns).

Key Recommendation 3: Strengthen the project design to stimulate market creation effects

The approach of drawing suppliers to hard-to-reach markets through the Mwangaza Mashinani project seems to have been effective. This market-based approach is important, in order to provide households with access to repair services and spare parts, as well as access to higher-level products in the future.

The project currently offers two incentives to suppliers to expand into underserved markets: higher than market price unit costs for solar devices, and a payment guarantee. In Phase 2, and at scale,

implementers should retain the de-risking mechanism, such as the 85% guarantee offered to suppliers, to leverage private sector financing and to support considerably de-risked opportunities for the private sector in a traditionally commercially unattractive sector. This will be important if the project is expanded to even more remote areas. However, the project could consider altering the mix of incentives offered to solar suppliers, to lower the cost of the product for households, and to lower the cost of the project for implementers, by offering higher levels of guarantee to suppliers who offer lower unit costs for the solar devices.

Key Recommendation 4: Refine and implement the communication and engagement strategy

As part of the implementation of Phase 2 or the scaled up project, it is imperative that a strong communication and engagement strategy is developed to strengthen the processes of communication, outreach, and sensitisation. This would ensure that beneficiaries and other stakeholders are aware of key project processes and resources at their disposal. This could be achieved through several actions, including, but not limited to, the following:

- During the preparatory stages of implementation, the project should engage and sensitise structures at all levels (i.e. local government, chiefs, assistant chiefs, BWCs, and CCs) so that they are able to fully support households during the project. Chiefs, CCs, and BWCs should be properly trained on dealing with grievances relating to the project, and households should be sensitised on the appropriate POCs for each type of grievance. Clear channels for maintaining ongoing communication with these structures during implementation should also be established.
- The project's communication strategy should utilise a combination of communication channels, including in-person meetings (e.g. *barazas* followed by smaller group meetings to provide information to the most vulnerable and marginalised households), especially in remote areas where radio and/or television transmission is limited.
- Project sensitisation should take place prior to engaging potential beneficiaries, and should focus on all aspects of the project's delivery systems, including targeting and enrolment, selection of devices, installation and maintenance, payments and repayments, grievance mechanisms, and the role of CCs. The strategy should also consider how best to engage households to ensure that they are fully informed before deciding whether to participate in the project and, later, selecting their device.
- The strategy should consider whether and how the BCC component should be included in Phase 2 as, in spite of limited BCC in Phase 1, households use their devices frequently and in line with the project ToC (i.e. for livelihood activities and to allow children to study at night). In fact, findings from other programme evaluations of cash transfers that are coupled with BCC show that 'low-intensity' BCC activities can have large impacts on people's knowledge and beliefs.[57]

Key Recommendation 5: Project messaging should motivate children to use the solar lights to study at night

The impact evaluation of the Mwangaza Mashinani pilot project has shown that the provision of solar devices for lighting to households with school-going children is an effective way to increase children's study hours at home, particularly at night. To strengthen this channel of impact, project messaging should focus on encouraging households to motivate children to use the solar lights at night to study. Findings from other cash transfer evaluations have shown that simple messaging (e.g. naming a cash transfer programme a 'child grant') can encourage households to use the cash, or in this case device, in line with

[57] See Carneiro *et al*. (2019) 'Child Development Grant Programme Evaluation Quantitative Endline Report Volume I: Final Endline Findings', OPM, Oxford, UK. www.opml.co.uk/files/Publications/cdgp-endline-vol-i-final.pdf?noredirect=1

the programme's objectives.[58] As also discussed in related research by OPM, the distinction between conditional and unconditional transfers is less clear-cut than is often described.[59] Even in the absence of explicit conditionality, messaging can be a powerful instrument to strengthen programme effectiveness.

Key Recommendation 6: Review the project design with an explicit gender equality and social inclusion lens

Gender should be explicitly incorporated into all stages of the project's design and implementation. This could be achieved, for example, by following the United Nation's Gender Equality and Social Inclusion framework, to systematically address issues related to gender and inclusion. For example:

- The BCC should be tailored to female and male beneficiaries: for example, tailored communications around promoting the benefits of solar energy, which might be different for men and women (see the baseline results), ownership and usage of the product, which may have unintended impacts on women's time poverty, and maintenance of the product and capacity building (e.g. focusing on training female agents and CCs, while taking their needs into account, such as security concerns, means of travel etc.).
- The project should consider whether all the categorical targeting criteria are required, or whether different categorical criteria might be more appropriate to improve inclusion. For example, the project could focus on targeting all households residing in geographic locations that do not have access to electricity. This could be achieved by targeting vulnerable households through the Enhanced Single Registry, which will contain data on vulnerable households not enrolled in the cash transfer programmes.
- Targeting and eligibility criteria could also focus on female beneficiaries, who are more likely to be motivated to obtain a device to enable children to study at night.

Key Recommendation 7: Document protocols for payments and grievance and case management

Given the crucial importance of making regular repayments in order to use the solar devices, project implementers should develop and document contingency protocols to guide implementation in the case of Inua Jamii payment delays. These protocols for extending light to households to prevent deactivation of the devices should be developed and agreed with suppliers in advance of implementation. For suppliers, this might include pricing in a risk premium. For households, more flexible repayment plans (e.g. daily/weekly, rather than bi-monthly) might be more suitable, contingent on being acceptable to suppliers. Further research could focus on the acceptability of alternative repayment and financing mechanisms and repayment behaviour using these alternative mechanisms, for example.

In preparation for Phase 2 and scale-up, the project's grievance and case management procedures should be reviewed, consolidated, and documented. To simplify the process for households and to improve service delivery, these procedures should allow households to lodge any type of grievance (e.g. related to payment of cash top-ups or device maintenance) with any of the grievance channels. Project POCs, including chiefs, CCs, and BWCs, should be properly trained to deal with any grievance or case management issue related to the project, including how to escalate, delegate, and/or resolve issues.

Key Recommendation 8: Strengthen the project's monitoring and evaluation processes

[58] See OPM (2014) 'Child Grants Programme Impact Evaluation. Follow-up Report', OPM, Oxford, UK. https://assets.publishing.service.gov.uk/media/57a089b2ed915d622c00035d/draft_CGP_Follow_Up_v11_out.pdf
[59] See Pellerano, L. and Barca, V. (2014) 'Does one size fit all? The Conditions for Conditionality in Cash Transfers', OPM, Oxford, UK. Available: https://reliefweb.int/report/world/does-one-size-fit-all-conditions-conditionality-cash-transfers

The project should develop a proper monitoring and evaluation framework. This framework should be based on clearly articulated targets (which may need to be periodically updated in light of the evolving circumstances), indicators (accompanied by clear definitions), data sources, and responsibilities for reporting against these.

The accuracy of data collected and stored in the MIS should be enhanced by developing standardised reporting templates that are agreed and used by all stakeholders, to consistently report project information. This includes developing a harmonised approach towards the identification of beneficiaries by ensuring that consistent, unique identifiers are used.

There is also a need to improve the process of using monitoring data so that feedback and lessons learned are rapidly implemented. For example, the monitoring dashboard showed that, in payment cycle 1, some beneficiaries faced issues making repayments using tokens and remedial action should have been taken prior to the second pay cycle.

Finally, the project MIS should link to the SPS's Single Registry, and, once rolled out, the Enhanced Single Registry, either directly (which would be preferable) or using the complementary module.

Key Recommendation 9: Provide maintenance support to households beyond the 12-month repayment cycle of the project

The project design needs to be revised to better support households with the maintenance of devices. Without additional support, the endline findings suggest that there is a risk of mass failure of devices in the next few years (especially as batteries get weaker and need replacing), resulting in solar waste. This could be achieved in a number of ways:

- As affordability remains a key constraint for households, the project may need to continue to provide a small top-up to households to help to pay for repairs. Alternatively, a longer repayment period could help to reduce the monthly repayments and make maintenance, as well as replacements, more affordable.
- BCC activities could focus on supporting households to identify the maintenance needs of their devices. In many cases, households are unable to distinguish between installation issues (e.g. loose wires), minor repairs, and larger issues, which can lead them to conclude that their device is not functioning.
- BCC activities could also sensitise beneficiaries to the types of maintenance issues they are likely to face, and the related costs, so that they can save to pay for these.
- The project can expand and strengthen the formal role of CCs, so that they are able to continue to provide support to households as they begin to experience maintenance issues beyond the project cycle. This could be achieved by creating a cadre of service providers (i.e. CCs) in the community to manage repair and maintenance services, for a small fee. This would provide work and regular income for that cadre, and would provide an affordable system for sustaining the solar devices within the community.

Key Recommendation 10: Revise the project ToC

We recommend that project implementers revise the ToC to update the impact pathways and underlying assumptions based on learnings to date. In particular, a revised ToC should be realistic about what types of socio-economic impacts can be achieved, particularly in relation to health and livelihoods, given the relatively low level of lighting provided by the solar devices. Equally, the project should not underplay the value of the unintended, positive effects that occurred for households in relation to well-being, safety, and

social capital, and should consider including explicit impact pathways related to these unintended impacts.

Finally, to refine the impact pathway related to impacts on education, further research could investigate the links between increased study hours and children's performance at school. Due to the difficulty of obtaining data on school grades achieved by children, coupled with the effects of the COVID-19 pandemic, a full assessment of the link between study hours and children's school grades was not possible as part of this evaluation.[60]

[60] We do find a positive impact on grade promotion. However, this only represents the short-term impact of the project that would have materialised between baseline and January 2020. See Section 5.4.2.2 for more details.

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